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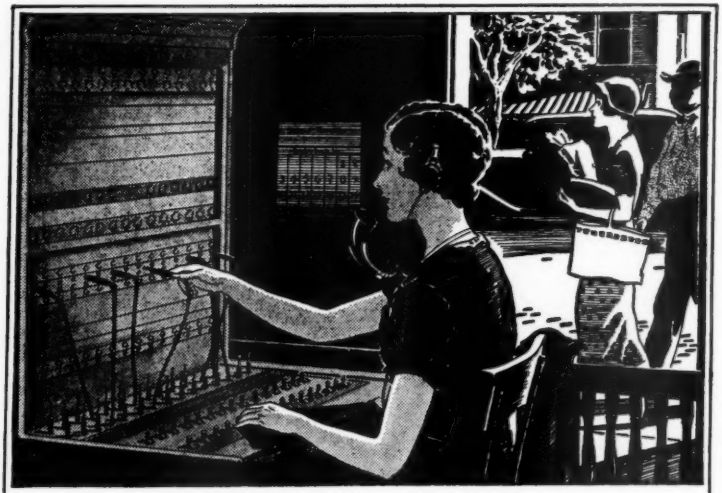

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THE TIMES CALL FOR TEAMWORK

By W. E. WICKENDEN, President of the Society

A crucial year such as this brings to our Society not only added problems and perplexities, but also a more significant part to play for the common good. The die is cast for a bold national experiment in which success means a radical economic reconstruction, and failure may lead to chaos and possible revolution. For the emergency, we are all in the same boat. What may happen to each man and institution depends upon what happens to the boat. Public revenues, income from endowments, tuition earnings, enrollments, college budgets, outlets for graduates, teachers' incomes, and the cost of living are all bound up with the fate of the ship and there is little we can do about the matter individually. Collectively we have a voice and may wield an influence.

The new national policy puts responsibility into the hands of self-governing functional groups—"modern guilds," as President Roosevelt calls them. Through these associations we are to share in shaping the social order even more than through our daily work or our election-day ballots. It would be a calamity if the new deal should reduce us all to a dead uniformity. These corporate units in a new society must serve to protect individuality as well as to fit together the members of a vast coöperative framework—not only to insure that certain functions will be adequately performed in harmony with other functions, but equally to insure ample scope within that framework for institutions and persons to evolve along the line of individual genius. Our Society has anticipated the new deal, for it has been developing into just such a corporate guild of engineering educators and colleges these last forty years.

Collectively, we shall have to study the effects of the codes on the great technical industries, to be alert to all the implications of shorter hours and a wider spread of purchasing power, to consider what we are to contribute to education for leisure-time activities, to build up contacts with the quasi-official trade associations, to press our concerns in the Engineers' Council for Professional Development, and to be prepared for any action which may be asked of us under the National Recovery Acts.

It is well to remind ourselves that the educational framework is changing almost as rapidly as the economic framework of society. The junior and senior high schools, the junior colleges and the arts

colleges are all in a state of flux. Only one thing seems certain—that the present units and sequence of our familiar educational system are not permanent but transitional. It seems to be only a question of time until more extended opportunities for general education and for vocational training will be widely offered under public auspices. Where will the school of engineering fit most effectively into the altered framework? Will it become more definitely professional in character? If so, what is to be done about other forms of technological education more specific in purpose? Ought we to anticipate probable changes by altering the length of our curriculum, by dividing it into preliminary and professional stages, by facilitating the entrance of junior college graduates, or by granting credits for post-graduate courses in high schools? With hours of work in industry and business universally reduced, can we continue our traditional policy of giving five years of college education in four? If the junior college becomes a widely established part of preliminary education, will less than a three-year further program suffice? Will a longer normal program endanger our hopeful progress in post-graduate work? We are fortunate to have in this Society a common forum for these issues.

Within our sphere of special activity important questions are to be faced. The Board of Investigation and Coördination is terminating ten years of fruitful work. The conclusion of its reports by the publication of Vol. II is anticipated within the very near future. Its summer schools have, during seven years, completed the cycle of the principal subjects of instruction. In these ten years we have acquired an envied position among college teachers. A sense of unrest and uncertainty has given place to a sense of assurance. Our relations with industry and the profession have grown intimate and cordial. Criticism has turned into constructive channels. Our efforts for the improvement of teaching have been widely pointed to with praise. Our teachers have been bound together into an intimate fraternity. We have come to feel that no other branch of undergraduate education has been more successful in approaching its objectives. There are the happy fruits of the Board's wise policy in promoting a program of stimulation rather than one of standardization. Now we face the crucial question—can the Society conserve and extend these fruitful activities through its own resources and its regular organization?

For a time, it seems, the phase of expansion in most of our institutions is over. Our objectives will be qualitative, rather than quantitative. We shall be concerned with conservation and internal betterment. We may have less turnover and less influx in our teaching forces. Our business will be to develop the men we

now have. What engineering education is to be ten years hence is largely in the hands of men who are now assistant professors. These men should be the special concern of the Society; our responsibility is to discover the potential leaders, to afford them opportunities to be heard and recognized in wider circles and to give them responsibilities in fields broader than their specialties. Much of this work of discovery and nurture ought to be done by our Sections, Branches and departmental Divisions.

The times call for teamwork—this may give us a keynote for 1933–34.

R. A. SEATON, President of the Society, 1932–33.

ROY ANDREW SEATON

President of the Society, 1932–33

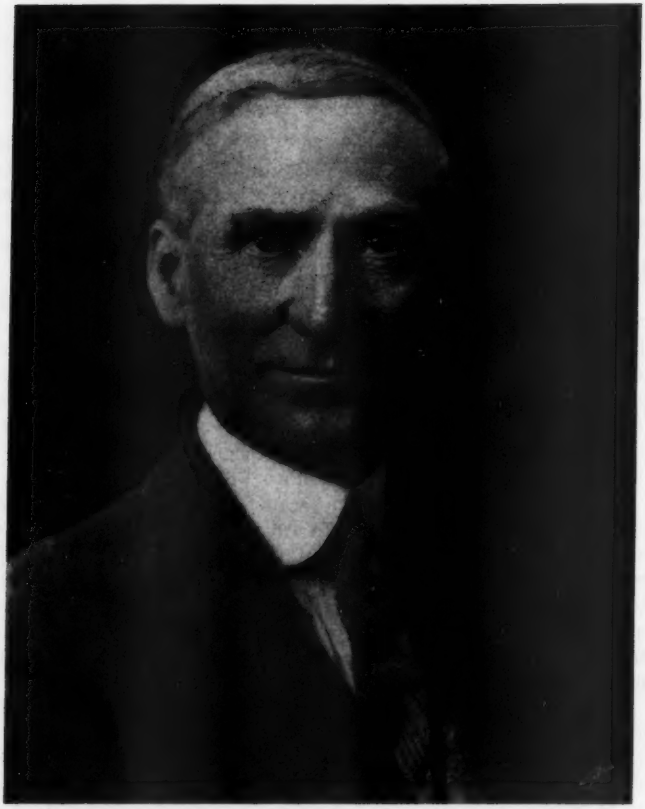
Roy Andrew Seaton was born in Glasco, Kansas, April 17, 1884. He received the degrees B.S. in M.E., and M.S. at the Kansas State College in 1904 and 1910 respectively, and S.B. in M.E., Locomotive Option, at the Massachusetts Institute of Technology in 1911. In the summer of 1908 he studied hydraulics at the University of Wisconsin.

Since graduation Dean Seaton has been continuously employed by the Kansas State College, with occasional leaves of absence for advanced study, for industrial experience, and for army service. He taught mathematics from 1904 to 1906 and mechanical engineering from 1906 to 1910. He was Professor and Head of the Department of Applied Mechanics and Machine Design from 1910 to 1920 and Dean of the Division of Engineering and Director of the Engineering Experiment Station since 1920.

During the summer of 1907 Dean Seaton worked in the locomotive repair shops of the Santa Fé railroad at Topeka, Kansas. In 1911–12 he was employed as a designing draftsman by the General Electric Co., at Lynn, Massachusetts, working on steam turbines, centrifugal compressors, and other high speed machinery. In 1918 he served about ten months as Captain in the Engineering Division, Ordnance Office of the U. S. Army, designing artillery ammunition.

He is author of a textbook "Concrete Construction for Rural Communities" and numerous articles and papers which have appeared in technical publications. He is a member of the American Society of Mechanical Engineers (past vice-chairman Mid-Continent Section); Kansas Engineering Society (vice-president and acting president 1929–30 and president 1930–31); Engineering Section of the Association of Land-Grant Colleges and Universities (secretary 1925–29 and chairman 1929–30); Phi Kappa Phi; Sigma Xi; Sigma Tau; a fellow of the A.A.A.S.; and an honorary member of the A.A.U.P. He has been chairman of the Kansas Registration Board for Professional Engineers since its organization in 1931.

Dean Seaton was a charter member of the Kansas-Nebraska Section of the S.P.E.E. and served as its secretary in 1920–22 and its chairman in 1923–24. He was a member of the Council of the Society 1926–29, and vice-president and chairman of the Committee on Sections and Branches 1930–31, and chairman of the Committee on Engineering Research 1929–32.



Dexter Simpson Kimball

DEXTER SIMPSON KIMBALL, Dean of the College of Engineering and Professor of Industrial Engineering, Cornell University, Ithaca, New York, awarded the sixth Lamme medal by the Society for the Promotion of Engineering Education at its fortieth anniversary meeting in Chicago, Ill., June 26–30, 1933. He was born at New River, New Brunswick, Canada, October 21, 1865. His parents, of Scottish descent, were William Henry and Jane Patterson Kimball. Soon after his birth his parents

moved to the Pacific Northwest Coast. Here at the age of sixteen, Dean Kimball began his engineering career, first as an apprentice and journeyman with Pope and Talbot of Port Gamble (1881–87), followed by shop experience in the Union Iron Works at San Francisco (1887–93) and finally in the engineering department of the same firm (1893–96). He then entered Stanford University, receiving the degree of A.B. in 1898. The work for this degree was of a strictly engineering nature.

Immediately after graduation began the long climb to fame as one of the outstanding engineers and engineering educators in this country. He was designing engineer for the Anaconda Mining Company in 1898, and started his teaching career as assistant professor of Machine Design at Sibley College, Cornell University, in the fall of that year. He brought to this position an extended experience of fifteen years in the field of practical engineering. Called in 1901 to Pittsfield he was until 1904 works manager of the Stanley Electric Manufacturing Company. The experience gained in this position undoubtedly formed the foundation and stepping stone for the development of educational work in industrial engineering to which Dean Kimball devoted himself after his recall to Sibley College as Professor of Machine Design in 1904. Under the leadership of Dean A. W. Smith, Professor Kimball introduced into the curriculum of Mechanical Engineering a course in industrial education which was at first tentatively called, "Principles of Manufacturing." This course at Cornell developed into a course called Industrial Organization, required of all M.E. students, and was the beginning of a Senior option in Industrial Engineering. In conformity with his major interests, Professor Kimball's title was changed to that of Professor of Industrial Engineering in 1915. His work was logically crowned in 1931 by the introduction of a complete four year course in Administrative Engineering, a curriculum designed to fit men for the great borderland between engineering and business.

Paralleling this work of education, Dean Kimball devoted a part of his energies to the writing of texts in his field, certainly a virgin tract in 1904. He is the author of: "Elements of Machine Design" (with J. H. Barr), 1909; "Industrial Education," 1911; "Principles of Industrial Organization," 1913; "Elements of

Cost Finding," 1914; "Plant Management," 1915; "Industrial Economics," 1930.

Several of these texts, notably the Machine Design and the Principles of Industrial Organization, have had wide adoptions as texts in engineering schools and all of the books had a wide circle of readers among students and practicing engineers.

He is, in addition, the author of over 200 articles published in various professional journals. These articles deal with a very wide range of subjects, machine design, industrial engineering, engineering education, etc.

The prodigious activity and versatility shown in this literary work, coupled with a marked gift for the public platform, could not fail to draw the attention of his co-workers in the field of engineering, particularly of engineering education, and recognition of the most marked kind has fallen to his lot.

He has been Dean of the College of Engineering at Cornell University since 1920, and has twice been acting President of the University (July–October, 1918, and November 1929–February 1930). He is a member of Phi Kappa Phi (President Cornell Chapter 1930–31), Tau Beta Pi (National President 1922–23) and Sigma Xi.

Dean Kimball has been especially active in the affairs of the American Society of Mechanical Engineers and of the Society for the Promotion of Engineering Education and has been the recipient at their hands of the highest official positions at their disposal. Of the latter society he has been a member since 1915. He was Vice-President of the Society in 1922–23, and President 1928–29. He was a member of the Council in 1928, and is now a member of the Board of Investigation and Coordination and Chairman of the Committee on Graduate Work.

The American Society of Mechanical Engineers honored him with a Managership in 1919–21 and with the Presidency in 1922.

The colleges were equally appreciative of his accomplishments and the honorary degrees conferred include, M.E. Stanford, 1913; LL.D. University of Rochester, 1926; D.Sc. Case School of Applied Science, 1930.

In addition to these honors, the list of activities includes: Member of the Council on Industrial Education, New York State Department of Education, 1911; U. S. Fuel Administrator for

Tompkins County, 1917–18; Director Training School for Army Mechanics, Cornell University, 1917–18; Member of Board of Visitors, Naval Academy, 1922; Member Staff Alexander Hamilton Institute, President of Board, 1929; Chairman, Commission of Rochester Mechanics Institute, 1926; Steinmetz Lecturer, 1929; Brackett Lecturer, Princeton, 1929; Chairman, John Fritz Medal Board, 1929; First President Hoover Medal Board, and presented first medal to President Hoover, 1930; Director, McGraw-Hill Publishing Company, 1929; Lecturer Stanford Graduate School of Business, 1930; Member H. L. Gautt Medal Board, 1929.

It is given to but few men, and fewer educators, to look back upon so extended and so complete a list of accomplishments in the fullness of their years.

To those who have been fortunate enough to watch Dean Kimball's career for the past thirty years, the outstanding facts appear to be pioneering in the field of industrial education and the tremendous influence his writings and addresses have had upon the development of this field in this country. To this must be added recognition of his all-pervading sense of fairness in all human relations and of his unflagging support of all plans for the betterment of industrial conditions and the advancement of technical education.

FUNCTION OF ENGINEERING SCHOOLS IN THE ECONOMIC LIFE OF THE COUNTRY *

By R. A. SEATON,

President of the Society; Dean, Division of Engineering, Kansas State College

Engineering colleges were originally established and developed in this country to bring to industry the benefits of science. This was the expressed purpose in unsuccessful attempts to develop such schools in the early part of the nineteenth century. Rensselaer Polytechnic Institute, the first successful civilian engineering school in this country, was founded in 1824 "for the purpose of instructing persons who may choose to apply themselves in the application of science to the common purposes of life . . . to agriculture, domestic economy, the arts and manufactures." The same fundamental purpose was declared in the Morrill Act, passed by Congress in 1862, which resulted in establishing and developing Land-Grant Colleges in every state in the Union.

Engineering in America during this early period was largely empirical in character and rough and ready in its methods. It was based upon practical experience in construction gradually accumulated through the years and handed down from one generation to another.

The work of the engineer continued to be chiefly in the field of civil engineering until in the eighteen eighties. Mining engineering and mechanical engineering curricula were first offered in America in the 60's, and electrical engineering curricula in the 80's, while the American Institute of Mining and Metallurgical Engineers was not organized until 1871, the American Society of Mechanical Engineers until 1880, and the American Institute of Electrical Engineers until 1884.

Progress in the development of collegiate engineering education was slow for many years. In the thirty-one years from 1835, when the first engineering degrees were conferred by Rensselaer, to 1866 a total of only 300 such degrees were conferred by all of the colleges in this country, and fully two thirds of these degrees were conferred in the last six or seven years of that period.

Growth in the number of engineering schools and in the number of engineering students occurred at an accelerated rate, how-

* Presidential Address delivered at 40th Anniversary Meeting, S. P. E. E., Chicago, June 26–30, 1933.

ever, after these early graduates reached maturity in their professional lives and demonstrated the value of collegiate engineering training. In 1870 there were about 21 engineering schools, in 1880 about 85, and in 1893, when our Society was organized, more than 100. The number of engineers being graduated annually also rose rapidly during these years, from only about 50 from all engineering colleges in 1866, to about 100 in 1870, about 230 in 1880 and about 1000 in 1893. Comparing these numbers with the nine to ten thousand now graduated annually, and keeping in mind the number of years that must elapse after graduation before the full effect of the college training is felt in our economic life, it is evident that while our engineering schools have, for many years, been powerful forces in the economic life of our country, the full nature of their influence has been felt but recently.

By the time of the organization of our Society in 1893, engineering and engineering education in this country were well established upon a professional basis, largely as the result of the work of the engineering colleges and of their graduates. By this time the earlier antagonism between classical education and education in pure and applied science had been largely overcome, and scientific education had become firmly established in the colleges and in the esteem of the people of this country. Professor DeVolson Wood, first president of this Society, said in his presidential address to the Society in 1894: "We meet under auspices favorable and peculiar. Favorable because the antagonisms of the past between classical education and scientific education have passed away. There has been a surrender or a truce. Engineering education and abstract scientific education have become closely allied, and technical schools and scientific courses are no longer suppliants for favor at the hand of the traditional educator. Meager preparation and narrow scientific courses of three years, barely tolerated, have expanded into the technical school, with its four or five years' course, demanding high preparation, well manned with instructors and well endowed with its millions. For money it now appeals not in vain. Scientific education has conquered the prejudices of the past and with a broader field of view there is no reason why all learning, knowledge, and education should not, under a common bond, live and flourish in peace." *

In this same address Professor Wood stated: "It may be safely asserted that there is not a demand in the country for 1,000 or more new professional engineers annually, but the fact that that number find useful employment, and that these schools are more and more crowded with applicants, shows that this kind of education is growing in popularity. But all of the graduates do not

* ENGINEERING EDUCATION, Vol. II, p. 21.

follow the profession of their school for life's work. These schools have opened new lines of work, and raised the standards of others, as well as enlarged the field of engineering. Graduates are found in many, if not in all of the other learned professions, and in many departments of business. It therefore becomes doubly important that this education should be conducted on correct principles; that while the subjects for study are those of engineering, they should be so handled as to develop the mental powers." *

Quoting further from this same address, "This Society is to exert an influence, and it is hoped a lasting influence on engineering education. Let the foundation be well laid to serve, not only the purposes of today, but of the future. Let it be enduring. The possibilities of the future are great with hope, and the educated engineer is to be one of the important factors in the development of the resources of the world. Already the lives of individuals and the fortunes of men are at his disposal." †

Engineering was still concerned chiefly, at this time, with the technical activities involved in utilizing the materials and forces of nature in structures and machines. The management, executive, and economic functions of industry were not yet considered to fall within the scope of the engineer's proper activities, at least to any large extent. He was the *master* of materials and forces but was still the *servant* of industry.

In the latter part of the nineteenth century and the early part of the twentieth century significant developments in industry greatly enlarged the responsibilities of the engineer. With the advent of labor-saving machinery, of rapid means of transportation and communication, of mass production on a large scale, and of the use of enormous amounts of power in industrial and domestic activities, the engineer was called upon in an ever increasing degree to assume executive and managerial positions and to apply engineering methods of thought and action to human and administrative problems as well as to materials and forces. It devolved upon him to perfect industrial operations and organization, to eliminate friction and antagonism between capital and labor, and to secure their effective coöperation for maximum production.

To function satisfactorily in this new field it was necessary for the engineer to become a master of men and of industry, as well as of materials and forces. He had to make use not only of the laws of physics and chemistry, but also of the less tangible and less definite laws which govern the behavior of men. He had to ascertain the fundamental facts underlying social and economic inter-

* *Ibid.*, p. 24.
† *Ibid.*, p. 36.

ests, as well as mechanical efficiency, and to apply these facts in the management of industries.

The successful work of the engineer in the new field of industrial management was due in no small measure to the sound fundamental training he had received in the engineering schools in the scientific method of approach to his problems, in correct and logical thinking, and in the elimination of guess work so far as possible, and the substitution for it of accurate knowledge, definitely ascertained relationships, and sound judgments and estimates based upon all the available facts.

During this period, too, the field of engineering became much broader and more complex through new discoveries in the basic sciences and new applications of these discoveries, and this led to the division, the subdivision, and the re-subdivision of the various branches of the field. Civilization became intensely and extensively industrialized, while the field of engineering became as broad as industry, which is to say, as broad as civilization itself. The work of the engineer came to enter into all the daily activities of all the people of the civilized world. Engineering and its allied arts became the basis of our civilization.

The growing complexity of the field of engineering and the increasing demands made upon the engineer demanded a high type of technical training that could be secured only by the aid of the engineering schools. While in earlier years many men had entered the profession without collegiate technical training, and, through experience in working with and under the direction of other engineers and through self-directed study, had learned the essentials of the work of the profession, this method of training was no longer adequate, and it became generally recognized that collegiate engineering training is practically essential for anyone who is to secure any considerable degree of success in the work of the profession.

In the recent investigation of engineering education by this Society it was found that "Forty years ago less than a quarter of the members of national engineering societies were college graduates; to-day more than two thirds of those entering their membership hold college degrees and more than four fifths have had a substantial amount of college training." * In this connection should be noted, however, the further statement, "College training has become the normal first step to professional standing, but engineering education can not be reduced to a scholastic process alone. Experience in subordinate capacities under the direction and criticism of qualified practitioners is an indispensable part of the training of engineers." †

* Report of the Investigation of Engineering Education, 1923–29, p. 631.
† *Ibid.*, p. 632.

With the assumption of the function of the management of industry by the engineer and the increased use of power and of automatic and semi-automatic machinery, production of goods of all kinds for human consumption was very greatly increased and the labor required for unit production was very greatly diminished. Increased production had always been the most imperative economic need of society, and great numbers of people had always suffered want, privation, and hardship because there were not enough goods to go around. For many centuries even the bare necessities for existence could be obtained by many only at the cost of unremitting drudgery and long hours of constant toil. But in recent years the engineer has made it possible to produce all kinds of goods, including food, so abundantly that production is now no longer the limiting factor in satisfying human wants. As Ralph E. Flanders stated in *Forum* in November 1930, "The engineer knows—all engineers know—that if some omniscient dictator were installed as ruler of the United States, they could provide for him raw material, machinery, and trained labor sufficient to flood, bury, and smother the population in such an avalanche of food, clothing, shelter, luxuries, and material refinements as no Utopian dreamer in his busiest slumbers has ever conceived." This solving of the problems of production has been accomplished as the direct result of the application of science to industry, and due credit for it must be given to the schools in which engineers have received their fundamental training and inspiration. As our own Dean Kimball stated recently, "The growth of engineering education during the last seventy-five years has been remarkable, and, in the last analysis, the college professor has been mostly responsible for the industrial development we now behold." *

A great deal of nonsense has been spoken and written in recent years about the monotony of factory labor, "the menace of the machine," so-called "technological unemployment," and the supposed necessity for limiting sharply the hours of labor and of throttling further scientific discovery and progress. These very machines, the abundant use of power, and the application of scientific discoveries, under the direction of the engineer, have relieved men of the slavery of want and the drudgery of unremitting toil necessary for bare existence and have provided the possibility of, but not the necessity for, abundant leisure. So long as there remain human wants that are not satisfied there is no real necessity for unemployment. Human wants are insatiable. The satisfaction of one want only gives rise to others. Provision of the bare necessities of life with lessened effort stimulates a desire for simple luxuries, and as these are provided they in turn become necessities

* *Mechanical Engineering*, January, 1933, p. 7.

and more and more wants are developed. We need not fear that production has developed or will develop sufficiently to satisfy all human wants, and that enforced idleness and privation will be the inevitable result. The standard of living will become higher and higher as the satisfaction of given wants can be accomplished with less and less labor, the only limit being how much of the labor which cannot be done by machines we are willing to do for the reward this labor will bring. It is only necessary that our economic system be modernized and brought into harmony with the condition of plenty provided by abundant production, so that all may have a proper share of the goods produced.

In an effort to bring about fuller realization of the benefits of the abundant production now possible, the engineer is now turning his attention to the problems of economic distribution of the products of industry, the control of the operations of industry as a whole in a planned economy, and the elimination of business cycles and of economic depressions such as the one from which we have been suffering for several years. Quoting from the recently published Encyclopedia of the Social Sciences,* "The principal economic surveys in the United States since the war have been made under the auspices of and largely by engineers. The President's Conference on Unemployment in 1921 was conceived, organized, and directed by an engineer, and as an outgrowth of it, three national surveys were set up to enlarge the general understanding of our economic system and to stimulate the continuing reduction of unemployment, the first, a study of business cycles and unemployment; the second, a study of seasonal operations in industry; and the third, a study of recent economic changes. The applications of fact finding, the basic factor in the technique of engineering, have yielded useful data. The question remains whether engineering as a profession will take the next step and apply to the social problem the basic factor of design. Will it design for industry as an organic whole the same technique of organization and management that it has made so effective in individual enterprise?

"Undoubtedly, by a compulsion of economic conditions that will eventually be done, but probably not by engineering as an organized profession. Individual engineers will of course take an important and constructive part."

Whatever may be the part that is to be played by the engineer in the solution of these larger economic problems of industry and of society, it is certain that his interest in the solution of these problems is very real, and he is now devoting much time and study to them. Technical journals and engineering society meetings for

* Vol. 5, p. 546.

several years have been devoted in large part to discussions of these problems. The American Engineering Council has already made several studies and reports of progress dealing with these questions, the latest being on "The Balancing of Economic Forces," presented early this year. While these economic problems do not fall exclusively within the field of the engineer, it would appear that his fundamental training in the scientific approach to his problems and in clear and logical thought processes, as well as his experience in the organization and administration of vast industrial enterprises, may well justify the hope that he can make a very considerable contribution to their solution.

As the engineer comes to play a more and more important part in our economic world, it is increasingly important that he be thoroughly and adequately trained for the work he is to be called upon to do. This training process is not the exclusive function of the engineering schools, as has already been pointed out, but the work of the engineering schools is a vitally important part of the process, and it is of the utmost importance to the economic welfare of the country that their work be well done. The character and quality of the training and inspiration given the young men in our engineering colleges today may vitally affect the industrial and economic welfare of our country when these men take over the control of industry ten, twenty, or thirty years hence. There is very grave danger in the widespread slashing of the financial support of engineering colleges which has been so prevalent in recent months. The retrenchments in these colleges made necessary by the reductions in their funds may result in the quality of this training being seriously impaired, with consequent injury to the industrial and the economic welfare of society in the years to come. It is highly important to the continued progress and welfare of this country that the engineering schools shall be able to continue to function and to function adequately in the following ways:

1. To attract into the colleges for preparation for work in the engineering field a sufficient number of young men of suitable mental, moral, and physical qualifications.

2. To give these young men such thorough undergraduate training in mathematics, in the physical sciences, in economics, in engineering technique, and in the humanities, that they may, with suitable post-graduate or post-scholastic training in industry become qualified for the operation and administration of industries and for the control and direction of industrial operations in the interests of society.

3. To give a considerable percentage of engineering graduates suitable post-graduate training in more advanced phases of the physical sciences, of the technique of engineering, and of indus-

trial economics, in order to give them a more solid foundation upon which to build careers of leadership in industrial and economic affairs. With the increase in complexity of engineering work, and with the extensions that have come in the field of engineering in recent years, collegiate post-graduate training is assuming greatly increased importance and the numbers of men pursuing such work have recently increased enormously. Dr. Walton C. John reports * that in 1921–22 there were 368 graduate students in the engineering schools of this country, while in 1925–26 there were 1,114 and in 1930–31, 2,939, an increase of 700 per cent in nine years.

4. To develop new knowledge in the fields of engineering and industrial materials and operations through investigation and research, and in doing so to train men for research careers in industry. This is an extremely important part of the work of engineering colleges, and one which has been too much neglected. Who, for example, can estimate the economic value of the researches in reinforced concrete by Professor Talbot at the University of Illinois, or of the training in research methods of Duff Abrams, W. A. Slater, A. R. Lord, F. E. Richart and others while they were working under his direction?

5. To collect, systematize, and prepare for publication in readily available form scattered engineering knowledge for the use of engineering students and practitioners, in text and reference books, bulletins, papers for technical societies, and articles in the technical press.

6. To coöperate with industries, technical societies, and other agencies in providing suitable facilities for that post-scholastic training so necessary for the full professional development of young graduate engineers. The Engineers' Council for Professional Development is now organizing machinery to provide better opportunities for such post-scholastic training, and, in the opinion of the speaker, engineering colleges should give much more attention and provide much better facilities than they have yet done for such education and training of young engineering graduates in industry.

7. To carry on extension activities with the coöperation of industry in educating industrial workers, and in re-educating for new work those who lose their places through technological advances and the shifting demands of industry.

8. To give wide publicity through the popular and semi-technical press, the radio, and other mediums to that information and knowledge which will help the general public to adjust itself to and profit to the largest possible extent by industrial developments,

* JOURNAL OF ENGINEERING EDUCATION, November, 1932, pp. 166 and 169.

such, for example, as the extension of the use of electricity to the farms.

Ours is a technological civilization, dependent to an ever increasing degree upon college trained engineers. The height to which our economic life can be developed, and the very maintenance of our civilization itself, depend very largely upon the caliber of the men attracted into the profession of engineering and the efficiency and understanding with which they carry on their activities. It is the function of the engineering colleges to give to young men preparing to enter upon professional work in this field the best possible training and inspiration for the difficult and important tasks they will be called upon to perform, and to prepare for their use, while in college and later, in the forms most suitable, all the information and data, both new and old, that can be provided to help them bring to the people of this country, in the greatest possible measure, the full benefits accruing from the application of science and the scientific method to industrial and economic problems.

The engineering colleges, through their graduates, have been responsible in a very large measure for the industrial and economic advances of the past fifty years and they undoubtedly will be responsible in larger measure for those that will be achieved in the years to come.

MINUTES OF THE COUNCIL MEETING, JUNE 26, 1933

Present: R. A. Seaton, President, Paul Cloke and H. S. Rogers, Vice-Presidents, W. O. Wiley, Treasurer, F. L. Bishop, Secretary, L. E. Akeley, C. Frank Allen, W. M. Cobleigh, L. E. Conrad, H. B. Dirks, A. M. Dudley, F. L. Eidmann, B. G. Elliott, H. S. Evans, W. E. Farnham, Augustin Frigon, A. M. Greene, D. C. Jackson, H. S. Jacoby, F. E. Johnson, Morland King, O. M. Leland, J. E. McDaniel, A. E. Norton, C. W. Park, G. B. Pegram, A. P. Poorman, A. A. Potter, R. I. Rees, Harry Rubey, R. L. Sackett, G. A. Stetson, A. N. Talbot, F. E. Turneaure. (34)

The Treasurer, W. O. Wiley, gave the financial report for the year 1932–33 which was received and ordered printed.

The Secretary, F. L. Bishop, reported the activities of the Society. This was accepted and ordered printed.

The Executive Committee recommended that for the next current year, beginning July 1, 1933, the dues for individual members be discounted in the amount of 20 per cent when such dues are paid prior to January 15, 1934, and that also all dues collectable after January 15, 1934, shall be for the full amount. Recommendation adopted.

The Director of the S. P. E. E. Summer School for Teachers of Engineering, H. P. Hammond, reported that two successful schools had been held last summer—English at the Ohio State University and Economics at Stevens Institute of Technology. He also announced that there would be a school for teachers of Mining and Metallurgy, to be held at the University of Wisconsin following the meeting of the Society in Chicago.

In the absence of the Chairman of the Board of Investigation and Coördination, Chas. F. Scott, who was detained due to an accident, Prof. Hammond announced that the Board would sponsor a Conference of Administrative Officers of Engineering Colleges to be held at the University of Wisconsin, July 2–7; and the Secretary made a report for the Board.

R. I. Rees reported on the relations of this Society with other engineering societies. Upon motion Council approved the adoption of the charter for the Engineers Council for Professional Development.

H. S. Rogers made a report on sections and branches which will be published in the JOURNAL.

H. S. Jacoby was elected to be one of the three representatives

of this Society on the American Council on Education. The other members are L. W. Wallace and F. L. Bishop.

Council authorized the retiring President, R. A. Seaton, to appoint a committee on instructional standards to study standards of instructional conditions, particularly those applicable to sizes of sections and to teaching loads. President Seaton appointed H. S. Rogers, Chairman, H. P. Hammond, W. C. John, Morland King and H. H. Jordan.

Invitations to meet in 1934 were received from Cornell University, Massachusetts Institute of Technology, Georgia School of Technology, University of Wisconsin, Rensselaer Polytechnic Institute, and all the engineering schools in New York City. Council voted to hold the 1934 meeting at Cornell University.

An invitation was read from the Texas Section of the Society inviting the Society to meet in Texas in 1936, their Centennial Year.

An invitation from Technocracy, Inc., to attend its meetings in Chicago was received and appreciation expressed for the information.

A letter from the Metropolitan United Front Committee was referred to the Executive Committee for action and the Council advised the Committee that we should take no definite stand in the matter.

Dean L. E. Akeley reported that the College of Engineering of the University of South Dakota had been discontinued by political action. This matter was referred to the Executive Committee in order that it may confer with the American Association of University Professors if it deems it advisable.

The following were elected to membership in the Society:

CASBERG, CARL H., Professor of Mechanical Engineering, University of Illinois, Urbana, Ill.

DIMICK, CHESTER E., Professor of Mathematics, Coast Guard Academy, New London, Conn.

GUSE, CLARENCE E., Instructor in Applied Electricity, Junior College, Los Angeles, Calif.

HAM, C. W., Professor of Machine Design, University of Illinois, Urbana, Ill.

HENDRICKS, WALTER, Professor and Head, English Department, Armour Institute of Technology, Chicago, Ill.

MEADOWCROFT, ALLAN J., Instructor in Engineering, Canal Zone Junior College, Balboa Heights, Canal Zone.

MILLIGAN, WILLIAM E., Assistant Professor of Metallurgy, Yale University, New Haven, Conn.

STRAITON, A. W., Assistant Professor of Engineering, Texas College of Arts and Industries, Kingsville, Texas.

The following budget was adopted for 1933–34:

Receipts

Dues individual members	$ 7,200.00	
institutional members	1,800.00	$ 9,000.00
Back dues		500.00
Advertising		1,500.00
Interest		200.00
Sale of publications		550.00
		$11,750.00

Disbursements

1933 Meeting	$ 475.00	
JOURNAL and Proceedings	5,000.00	
Committee expenses	75.00	
Secretary's honorarium	1,200.00	
Clerical assistance	3,300.00	
Postage, telegraph and telephone	250.00	
Sundry printing	225.00	
Supplies	100.00	
Dues	350.00	
Travel, Secretary's office	500.00	11,475.00
Estimated surplus		$ 275.00

F. L. BISHOP, *Secretary.*

MINUTES OF THE FORTIETH ANNIVERSARY MEETING AND THE FORTY-FIRST ANNUAL MEETING OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, CHICAGO, ILL., JUNE 26–30, 1933

The fortieth anniversary meeting and the forty-first annual meeting of the Society for the Promotion of Engineering was held in the Stevens Hotel, Chicago, Ill., June 26–30, 1933. Armour Institute of Technology was host to the Society for this meeting. There were 612 members and guests registered.

On Monday morning, June 26, there was a conference on English and Miss Sada A. Harbarger, Chairman of the Committee on English, was chairman. The following program was presented: "Methods for Increasing Effectiveness of English Composition," by Walter Hendricks, discussion leaders: Jos. A. Ayers, Robt. L. Blair, C. F. DeLaBarre; "Tests for Acceptable and Reliable Habits of Writing," by John M. Stalnaker, discussion leader, W. W. Hatfield.

In the afternoon the teachers of English held a symposium on Developing Reading Habits. The leaders were T. J. Donahue, W. R. Dumble, J. R. Lowe, and A. H. Townsend. H. L. Creek read a paper on the "Scope and Type of the English Teacher's Service."

The Division of Coöperative Engineering Education met the same afternoon with A. R. Cullimore presiding. "The Effect of the Present Economic Dislocation on our Coöperative Program" was presented by Geo. W. Burns, and W. H. Timbie told "How Massachusetts Institute of Technology Has Handled the Coöperative Course During this Situation."

The Division of Drawing and the teachers of English met at dinner that evening and the following program was carried out: "Illustrations of the Engineering Reports," by Thos. E. French; "Writing and Illustrating Engineering Material from the Sales and Publicity Viewpoint," by Ralph Leavensworth; "English of the Engineering Reports," by J. Raleigh Nelson.

Members of the Council and their wives were guests of Armour Institute of Technology at dinner at the Chicago Woman's Club.

The first business session was held at nine o'clock Tuesday morning, June 27, with R. A. Seaton, President of the Society, in the chair. Willard E. Hotchkiss, President of Armour Institute of Technology, welcomed the Society and delivered an address on the "Function of Engineering Schools in the Social Life of the Com-

munity." Vice-President Paul Cloke took the chair while President Seaton gave his presidential address, "Function of Engineering Schools in the Economic Life of the Country." This was followed by W. E. Wickenden on the "Effect of its Engineering Schools on the Economic Life of Europe," and by A. N. Talbot on the "Origin of the Society." The Treasurer, W. O. Wiley, presented his report which was accepted, and the Secretary, F. L. Bishop, gave his report which was also accepted.

Tuesday afternoon was devoted to the following conferences:

Coöperative Engineering Education. A. R. Cullimore, *Chairman.*

Coöperative Work as a Laboratory for Industrial Management for Personnel Problems and Problems in Human Relations; Some Suggested Forms of Technique. H. H. Metzenheim, Fred E. Ayer, Robert C. Disque, B. M. Brigman, E. H. Flath, S. Fishman.

Mechanics. A. E. Norton, *Chairman.*

Advanced and Graduate Study of Mechanics: Demands of Industry for Engineers with Better Understanding of Mechanics. G. M. Eaton.

What Shall We Do with Graduate Students? J. P. Den Hartog.

Demonstrations of Models Showing Vibration and Other Phenomena of Dynamics. J. G. Baker.

Joint meeting of the Division of Drawing and the Division of Orientation and Engineering Problems: "A Coördinated First Year Course in Engineering," E. R. Wilcox; "Advantages and Disadvantages of a Coördinated First Year Course," F. C. Dana; "General Rôle of Geometry in the Physical Sciences," F. W. Bubb; "Orientation Program at Purdue University," Justis Rising.

Joint meeting, Committee on Industrial Engineering and the Society of Industrial Engineers: "Place and Scope of Industrial Engineering in the College Curriculum," F. V. Larkin, Paul T. Norton, Dexter S. Kimball, Willard E. Hotchkiss.

The Society was the guest of Armour Institute of Technology at a smoker on Tuesday evening.

Wednesday, June 28, was Engineers' Day at the Century of Progress Exposition. Formal exercises were held in Soldier Field Stadium in the morning and Juan de la Cierva was presented with the Daniel Guggenheim Medal by the American Society of Mechanical Engineers for development of the theory and practice of the autogiro. The remainder of the day was spent in individual inspection of the Exposition.

In the evening a joint banquet was held at the Stevens Hotel and participated in by all of the engineering societies. The speakers were Edward J. Mehren and Karl T. Compton.

The second business session was opened by Vice-President H. S. Rogers on Thursday morning at nine o'clock. R. I. Rees, Chairman of our Committee, presented a report on the Engineers Council for Professional Development. "Change in Attitude of the Profession to Engineering Schools" was presented by A. S. Langsdorf, and "Interchange of Faculties of Engineering Schools" by D. C. Jackson. The latter was discussed by D. S. Anderson, J. W. Barker, O. J. Ferguson, H. S. Rogers, and G. C. Shaad. Wm. T. Magruder showed the Comparison of Present Curricula with Curricula in 1908.

On Thursday afternoon the following conferences were held:

Round Table on Junior Colleges. Walter B. Jones, *Chairman.*

Coöperative Engineering Education. A. R. Cullimore, *Chairman.*

Benefit of Coöperative Experience from Radio and Public Service Employment to Electrical Engineering Students. H. B. Duling.

Symposium: Value of Operation and Maintenance Work in the Coöperative Program, led by C. C. Winn.

Some Experiences with Operation and Maintenance Jobs in Industrial Work. Frank J. Oliver.

Mechanical Engineering. B. M. Brigman, *Chairman.*

The Mechanical Engineering Course. J. R. DuPriest.

Course in the Mechanics of Fluids. H. L. Mason.

Machine Design, F. L. Eidmann, *Chairman.*

Can Inventive Ability Be Developed by a Course in Mechanical Invention? Geo. M. Bartlett.

Sections and Branches, H. S. Rogers, *Chairman.*

History of the Organization of Sections and Branches. Chas. F. Scott.

Purpose, Function, Organization and Promotion of Sections and Branches. H. S. Rogers.

Coördinating the Sections with the National Society. R. A. Seaton.

Program Planning for Sections and Branches. D. S. Kimball.

Round table discussion.

On Thursday evening the annual dinner of the Society was held in the Tower Ball Room of the Stevens Hotel and the charter members were the honored guests of the Society. Each of the following was presented with a certificate of honor: William Sleeper Aldrich, Calvin Frank Allen, Lester Paige Breckenridge, William Hubert Burr, Mortimer Elwyn Cooley, William Henry Creighton, Fred Eugene Foss, Frederick Ernest Giesecke, Ozni Porter Hood, Leander Miller Hoskins, Dugald Caleb Jackson, Davis Schenck Jacobus, William Thomas Magruder, Charles David Marx, Dwight

Porter, Louis Ehrhart Reber, Palmer Chamberlaine Ricketts, Robert Lemuel Sackett, Arthur Newell Talbot, John Alexander Low Waddell, Sylvester Niles Williams.

President Seaton: Attention has already been called a number of times during this convention to the fact that we are celebrating our fortieth birthday anniversary, the Society having been organized in this city at the Columbian Exposition forty years ago.

On such an occcasion it seems fitting that tribute should be paid to the enterprising and far-sighted men who organized the Society so long ago. At an informal meeting held in Washington in November, the officers of the Society were requested to prepare a special certificate of honor to be presented to the charter members at this meeting. Such a certificate has been prepared and it reads as follows:

THE

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

1893–1933

HAS AWARDED THIS

Certificate of Honor

TO

CHARTER MEMBER

In Appreciation OF HIS FORTY YEARS OF VALUABLE SERVICE AS A LOYAL MEMBER, FRIEND, AND ZEALOUS CO-WORKER AND IN RECOGNITION OF HIS SUBSTANTIAL CONTRIBUTIONS TO THE DEVELOPMENT OF ENGINEERING EDUCATION AND THE PROGRESS OF THIS SOCIETY.

In Testimony WHEREOF WE HAVE HERETO SET OUR HANDS AND HAVE CAUSED THE SEAL OF THE SOCIETY TO BE AFFIXED AT CHICAGO, ILLINOIS, THIS TWENTY-NINTH DAY OF JUNE, 1933.

[Seal]

R. A. SEATON
President
F. L. BISHOP
Secretary

We are honored, indeed, that of the twenty-one surviving charter members ten are present this evening in person, and we trust that all of them are with us in spirit. Letters have been received from a number of those who, because of the infirmities of age, or the pressure of other duties, are unable to be present, and I shall read some extracts from these letters.

From William Aldrich: "I regret exceedingly not being able to attend the fortieth meeting of the Society for the Promotion of Engineering Education, and the reunion of its charter members. I wish for the Society continuous development of its aim and scope in its permanent contribution to the cultural, the scientific, the technical, and the professional, toward the utilization of the forces and resources of nature for the comfort and convenience of man."

From L. P. Breckenridge: "I am sorry indeed that I cannot be in Chicago for the meeting of the Society. I shall be interested to read anything concerning the early history of the Society. I remember some of it, but no doubt Professor Talbot will get together the material, and it will be accurate as well as interesting. Give my friends my kindest regards."

From M. E. Cooley, after expressing his regret that he could not be here: "Even otherwise I doubt if I could attend, for I am tired. My chief desire seems to be to find some snug retreat far from the madding crowd, a favorite pool where when I toss in a pebble, the red fins crisscrossing flash crimson traceries of lacey network on the surface. When you have a chance, try some poetic fancies on some of the hardened old sinners with whom I have been pals for many years."

From L. M. Hoskins: "The meetings in 1893 which led to the founding of the Society I remember with much pleasure and I regret my inability to renew the pleasure by attending the fortieth anniversary meeting. Please assure the officers of the Society of my sincere appreciation of the honor which is being extended to the founding members."

From Dwight Porter: "I cannot refrain, however, from strongly congratulating the active members of the Society upon the growth in membership and usefulness to the teaching profession that have resulted from their efforts."

Certificates will be mailed to those charter members unable to be here tonight.

I shall now take pleasure in presenting the certificates to those who are here, if Secretary Bishop will conduct them to me as I call their names. I regret that we shall not have time to have an address from each of them, but I hope each of them will say just a few words of greeting to the members of the Society.

C. Frank Allen: Thank you, and the Society, very much.

I have a great appreciation of the kindnesses and the honors that the Society has conferred upon me in the past.

Fred. E. Foss: Thank you very much.

Ozni P. Hood: Although I left a formal classroom some twenty-two years ago to enter government service, I find the characteristics that Dean Kimball mentioned are needed in government service, especially, at this time, a sense of humor.

William T. Magruder: I might add that I was also a member of the Mechanical Engineering Teachers' Association founded by my predecessor at Ohio State University, Professor Stillman W. Robinson, in 1891.

Palmer Chamberlain Ricketts: Thank you.

Robert L. Sackett: One of my most cherished memories is of the men who were responsible for founding this Society. They were of great assistance to me, a young teacher, through the addresses which they gave. I do not recall these addresses. I can find them in the proceedings of the Society. I recall their personal interest in the young people coming on, and the fine, inspiring character of these stalwarts who helped to make the Society.

Arthur N. Talbot: I made my speech last Tuesday, but I may add that the occasion of the formation of this Society forty years ago was to me a great event. It gave me an opportunity to meet and know these many man who were my seniors then, and whom I have looked up to and respected ever since.

John A. L. Waddell: One of the great satisfactions of my life has been in connection with this Society. When I joined as a charter member, I had taught engineering for six years, and I knew I would never teach it again because I had gotten into a large practice. But I wanted to keep in touch with engineering education, and I have done so ever since through this Society, sometimes by criticism that some of you did not like, but I wanted to see the profession advance. This very day I delivered a lecture to a very small group of people in the Hall of Science on "The Advancement of the Engineering Profession."

Sylvester N. Williams: I very much enjoyed the address of my honored Professor of Cornell University, and I heartily join in the invitation to come there next year and renew your acquaintance with us, as far as it may be convenient to do so.

I can only express my very high appreciation of all the influences which were showered upon me from the time I entered Cornell University in 1868 as a freshman up to the present time. It is my great pleasure to make a pilgrimage there every year, commencing with 1916, and I hope to see you there next year, God willing.

President Seaton: Mr. Williams, we hope that you and all of

these other charter members will make pilgrimages to the meetings of the Society each year hereafter.

"The Personalities of Engineering Educators" was given by Dexter S. Kimball, who spoke eloquently from his long experience with education and with educational teachers. He stressed the personalities of the men who teach the subjects because they affect us more than the courses taught. To him a great teacher is one who has scholarship, power of expression and particularly the power to illustrate, power to inspire, fairness to students, humor, appearance and character. He emphasized the necessity of careful selection of men to occupy places on our faculties. He said, "A great university community consists of a board of trustees, of the faculty, of the students in college, and of the alumni. One of the finest things that can come to any man is to be taken into one of these great families. It ought to be difficult for him to get in and just as difficult for him to get out."

O. W. Eshbach, Chairman of the Committee on Lamme Award, presented the report of that committee. The Lamme Medal is given each year to the chosen technical teacher for accomplishment in technical teaching or actual advancement of the art of technical training. The sixth medal was awarded to a man "who when that little beam of light that started the Century of Progress Exposition left the planet, Arcturus, entered upon an engineering career—Dexter Simpson Kimball." Responding to the award, Dean Kimball said, "I should be much less than human if I do not feel this honor very greatly and I am very greatly touched. We find comfort in some things that come to us and make us happy but there is nothing that comes to a man that makes him feel so good as the approval of his own co-workers. To be told by the other fellow that you have done a good job is worth a very great deal indeed. I am greated touched and I accept the medal very humbly and very gratefully."

C. Frank Allen, Chairman of the Nominating Committee, presented the following officers for 1933–34. Upon motion the Secretary cast the unanimous vote of the Society for them:

For President: W. E. Wickenden, Case School of Applied Science.
For Vice-Presidents: F. V. Larkin, Lehigh University; B. M. Brigman, University of Louisville.
For Secretary: F. L. Bishop, University of Pittsburgh.
For Treasurer: W. O. Wiley, John Wiley & Sons, Inc., New York City.
For elective members of Council: Fred E. Ayer, University of Akron; Karl T. Compton, Massachusetts Institute of Technology; J. B. Finnegan, Armour Institute of Technology; W.

N. Gladson, University of Arkansas; B. R. Van Leer, University of Florida; H. B. Walker, University of California; C. H. Willis, Princeton University.

President-elect Wickenden was escorted to the chair by Past Presidents Turneaure and Sackett. In response to his introduction by President Seaton, Dr. Wickenden said: "During the coming year, I hope to be as assiduous in the affairs of the Society as my predecessor, Dean Seaton.

"I must pay my tribute of affection and esteem to these charter members we have with us tonight. Surely, they builded more wisely than they knew, when they knit and welded engineering teachers together with these bonds of solidarity. My own active interest in the Society is a matter of the last ten years, and it has been a source of the greatest interest and appreciation to see the increasing degree to which engineering educators among all groups in the realm of higher education have demonstrated their capacity for working together. We are today far better fortified in the defense of our organization and methods of education than any other undergraduate division, and in a far stronger position to assert and defend our capacity to train and develop our successors than our colleagues who have been less active than we in the pursuit of their common interests.

"It has been my privilege during the past year, in association with representatives from other fields of higher education, who have studied the problem of improving college teaching, to learn something of the esteem in which this organization is held, and of the growing recognition of its active service, not only to engineering education, but to the entire field of higher education itself. The time has gone by when we needed to defend engineering education, and the time is at hand when we should commend it to our associates."

The third business session was opened by Vice-President Paul Cloke on Friday, June 30, and the following program followed: "Post-Graduation Education for Engineering Graduates," V. M. Faires; "Application of Educational Philosophy to the Educational Process in a Professional Engineering Course," R. S. Sweigert; "Promotion of Engineering Education during the past Forty Years," H. P. Hammond; "Engineering Aptitudes," Clair V. Mann; "Vocational Guidance in Engineering Lines," J. A. L. Waddell; and reports of committees.

The following resolutions were adopted:

This, the 40th Anniversary Meeting of the Society for the Promotion of Engineering Education, has assisted in marking an epoch in engineering service to the nation, and the contributions of many individuals and

organizations to the success of this meeting stand out as real services to the Society. We have learned to depend upon our President, Secretary, and their assisting officers for worth-while annual meetings and upon that group of devoted members who always contribute of their time and talents to make the programs instructive and inspirational. These efforts in our behalf we accept as the substance of our Society.

In addition to these services, rendered by members of our immediate family, we desire to recognize others which relate specifically to this meeting, and therefore,

We wish to express our appreciation to Armour Institute of Technology for the profitable week we have spent here in Chicago and to President W. E. Hotchkiss, Professor J. B. Finnegan, and members of its faculty for personal services which they have so generously given in the program of the meeting and in the details of our entertainment.

We wish further to express our appreciation to the officers of the Western Society of Engineers who conceived and executed the plan by which we and other engineering societies and organizations could be together this week and enjoy each other's meetings.

We wish also to express our indebtedness for the inspiration we have received by having with us at this meeting such a large proportion of our living charter members.

And further, we wish to express our appreciation to the McGraw-Hill Book Company for publishing in such convenient form and furnishing us without charge the attendance list of this 40th anniversary meeting of the Society.

And also, we wish to express our appreciation to the management of the Stevens Hotel for its generosity in providing us with meeting rooms and other services with careful consideration to our convenience but without cost to the Society.

W. M. COBLEIGH,
F. L. EIDMANN,
H. H. JORDAN,
G. W. CASE, *Chairman*

The meeting of the Institutional Division was held on Friday afternoon, Paul Cloke, Chairman. "New Opportunities for Technical and Engineering Graduates" was presented by Frank B. Jewett; "New Trends in Engineering College Curricula and Enrollments in the Light of the Present-Day Conditions," by Robert H. Spahr. Paul Cloke described the General Course in Engineering introduced at the University of Maine three years ago.

The Society has the following committees from Armour Institute of Technology to thank for the success of our meetings in Chicago.

General Committee: J. B. Finnegan, *Chairman,* W. W. Colvert, E. H. Freeman, E. C. Grafton, H. T. Heald, W. C. Krathwohl, Harry McCormack, J. F. Mangold, J. J. Schommer, A. W. Sear, S. M. Spears, J. S. Thompson, C. A. Tibbals, S. E. Winston.

Reception: C. E. Paul, *Chairman,* Herbert Ensz, R. J. Foster, E. H. Freeman, W. H. Seegrist, C. R. Swineford.

Registration: W. E. Kelly, *Chairman,* R. M. Cunningham, Jr., C. A. Nash.

Meetings and Entertainment: S. E. Winston, *Chairman,* C. E. Paul, C. A. Nash.

Women's Reception and Entertainment: Mrs. E. H. Freeman, *Chairman,* Mrs. W. M. Davis, Mrs. J. B. Finnegan, Mrs. E. E. Gill, Mrs. H. T. Heald, Mrs. W. E. Hotchkiss, Mrs. W. E. Kelly, Mrs. W. C. Krathwohl, Mrs. J. F. Mangold, Mrs. D. P. Moreton, Mrs. C. A. Nash, Mrs. C. E. Paul, Mrs. D. E. Richardson, Mrs. G. L. Scherger, Mrs. W. H. Seegrist, Mrs. C. R. Swineford, Mrs. V. B. Teach, Mrs. J. S. Thompson, Mrs. G. M. Wilcox.

The 1933 meeting adjourned to meet at Cornell University, Ithaca, N. Y., in June, 1934, the dates to be selected later.

F. L. Bishop, *Secretary.*

REPORT OF THE TREASURER, 1932–33

W. O. WILEY

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

STATEMENT OF CASH ACCOUNT

JUNE 15, 1933

BALANCE ON HAND—JUNE 20, 1932		$ 570.92
RECEIPTS:		
Current Dues	$ 9,237.49	
Back Dues	457.50	
Dues in Advance	169.80	
Sales of Publications	975.10	
Advertising	1,265.95	
Interest on Daily Bank Balances	53.97	
Refund—Lamme Award Fund	18.43	12,178.24
Total		$12,749.16
DISBURSEMENTS:		
Cost of Publications	$ 4,006.13	
Cost of Proceedings	420.47	
Honorarium for Secretary	1,200.00	
Salaries—Secretary's Office	3,300.00	
Traveling Expenses—Secretary's Office	307.49	
Printing, Postage and Office Supplies, etc.	729.17	
Expenses—Oregon Meeting, 1932	874.56	
Expenses, Chicago Meeting, 1933	57.34	
Dues—American Council on Education	100.00	
Dues—American Engineering Council	250.00	11,245.16
BALANCE ON HAND—JUNE 15, 1933		$ 1,504.00

Note—In addition to the above balance, there is on deposit at the Forbes National Bank, Pittsburgh, Pa., in Savings Account No. 3809 the amount of $6,000.00 with interest of $516.85 to June 1, 1933.

Society for the Promotion of Engineering Education

Income and Expense Statement

For the Year Ending June 15, 1933

Expense

Cost of Journal	$ 4,456.13
Cost of Proceedings	420.47
Expenses—Oregon Meeting	1,062.82
Honorarium for Secretary	1,200.00
Salaries, Secretary's Office	3,300.00
Printing, Postage and Office Supplies	729.17
Traveling Expenses—Secretary's Office	307.49
Dues—American Council on Education	100.00
Dues—American Engineering Council	250.00
	$11,826.08
Surplus for the Year	271.37
	$12,097.45

Income

Current Dues	$ 9,089.99
Back Dues	457.50
Sales and Publications	567.50
Advertising	1,329.70
Miscellaneous Income	407.60
Interest on Daily Balances	245.16
	$12,097.45

Society for the Promotion of Engineering Education

Balance Sheet

June 15, 1933

Assets

Cash:		
Current Fund	$ 1,504.00	
Petty Cash Fund	300.00	
Life Membership Fund	724.69	
Benj. G. Lamme Fund	262.77	$ 2,791.46
Savings Account:		
Forbes National Bank—No. 3809		6,516.85
Securities:		
Benj. G. Lamme Fund		5,000.00
Prepaid Expenses—Chicago Meeting, 1933		57.34
Inventory		1.00

Accounts Receivable:		
Current Dues	$ 240.00	
Advertising	240.82	
Lamme Medal Fund	1,000.00	1,480.82
Furniture and Office Equipment (Estimated)		100.00
		$15,947.47

LIABILITIES

Life Membership Fund		$ 724.69
Benj. G. Lamme Fund		5,262.77
Prepaid Membership Dues		169.80
Accounts Payable		450.00
Surplus Account:		
Balance at July 1, 1932	$ 9,538.34	
Less—Adjustment to reduce inventory to Book Value of $1.00	469.50	
Revised Surplus at July 1, 1932	$ 9,068.84	
Surplus for this Year	271.37	9,340.21
		$15,947.47

REPORT OF SECRETARY, 1932–33

F. L. BISHOP

This is the fortieth anniversary meeting and the forty-first meeting of this Society. It is proper at this time that attention should be given to the development and the history of the Society and its members. This is provided for first by presenting to the charter members certificates of honor, and by three addresses, "Origin of the Society" by A. N. Talbot, a charter member; "The Promotion of Engineering Education during the Past Forty Years" by H. P. Hammond; and "Personalities of Engineering Educators" by Dexter S. Kimball. These three addresses will cover the history of this Society during its forty years of existence. Consequently, the Secretary is omitting from his report material pertaining to the history of the Society.

This is the first time since 1909 that the annual meeting of this Society has been held outside of an educational institution. We are greatly indebted to Armour Institute of Technology which is our official host on this occasion and especially to Professor J. B. Finnegan for handling the difficult details in the preparation of the meeting.

It seems pertinent, due to the period of depression which we have been passing through, to state briefly the condition of the Society.

The Society has suffered, during the past year, a loss in membership of 34 or 1.4 per cent. The membership at the present time is composed of 2,265 individual members and 120 institutional members, making a total of 2,385.

The Treasurer's report shows that after all bills are paid there will be a small surplus on the year's operations.

None of the activities of the Society has been curtailed and some have been extended, notably sections and branches.

Such in brief is the status of the Society.

President Seaton appointed a Membership Committee early in the academic year of which the Secretary was chairman and one member was selected from each institution. The individual members of this Committee worked energetically and added 133 new members, two of which are institutional. There were 167 names removed from the rolls of the Society—15 deaths, 23 dropped, 127 resigned including three institutions.

Most members of this Society will receive a decreased salary

for the coming year. Some of the reductions in salary will be drastic. In view of this condition and in view of the need of the members for the Society, the Executive Committee will recommend to the Council that it offer to individual members a twenty per cent discount on all bills for dues paid on or before January 15, 1934. In other words, the individual member will be billed for $5.00 but will pay only $4.00 if such bill is paid on or before January 15, 1934.

The Institutional Division is becoming an effective part of this organization. Vice-President Cloke has given this matter a great deal of thought and consideration during the past year resulting in a well planned meeting of the institutional delegates. It is quite proper that this should end the regular sessions of the Society and be preliminary to the conference of administrative officers the following week at the University of Wisconsin. Undoubtedly some of the results of this conference will be referred to the Institutional Division for action.

Vice-President Rogers will make a report on sections and branches. This phase of the Society's work has been greatly developed during the past two years under the leadership of Dean Seaton and Dean Rogers. The country is now divided into geographical units so that practically all the institutions in the country are included in sections. Attendance at the sectional meetings last year, according to the Secretary's records, was 807. Attendance at some of these meetings is as large as the attendance used to be a few years ago at the annual meeting of the Society. President Seaton was able to attend many of these sectional meetings as widely separated as that of the Pacific Southwest Section, the Ohio Section, and the Texas Section. I believe sectional meetings is one of the most successful methods for the promotion of engineering education. Not only do the individual members receive benefits but it is developing a harmonious spirit among institutions.

We have been able to continue the summer schools for engineering teachers this year through grants received from the Carnegie Corporation and the Engineering Foundation. These schools since their inception have been under the able leadership of Dr. H. P. Hammond, who will present a report to the Council. We are carrying out this year a plan which has been under consideration since the first summer schools were authorized, namely, a conference of administrative officers of engineering colleges. The summer school for teachers of mining and metallurgy will be held at the University of Wisconsin. The Society is greatly indebted to Dean F. E. Turneaure and to the University of Wisconsin for serving as hosts to both of these conferences.

The Board of Investigation and Coördination is ending ten years of creative work. The inspiration which this Board has given during its life has been of very material benefit to engineering schools. Much credit is due to the members of the Board and to the staff, but credit is also due to those engineering educators who, prior to the organization of the Board, studied the conditions which engineering schools were encountering and so brought about the creation of the Board. We might almost add that the foundation of this Board was laid in 1893 when these men, whom we are honoring at this fortieth anniversary meeting, organized the Society. For thirty years, the members labored with their problems through committees of the Society. Much was accomplished through committees but the greatest accomplishment lay in the fact that engineering educators themselves had created an organization which, through its work, secured that recognition which was essential in securing the funds to carry on the work of the Board, and also recognition of the fact that an investigation of engineering education could be carried on through the schools themselves by a central body directing only this phase of the Society's activities. The Society is indeed fortunate in having Professor Charles F. Scott as chairman of this Board since its inception.

Despite the unsettled conditions existing in many engineering colleges the committee work of the Society has not suffered. The members of the different committees have worked as energetically as before. Many of the committees have alrady outlined their work for the coming year. A number are planning for luncheon and dinner conferences during this meeting.

At the informal meeting of this Society held in Washington at the time of the meeting of the Land Grant College Association last November, one of the main topics of discussion was the Engineers Council for Professional Development. The organization of this Council has been completed. Our representatives on it are R. I. Rees, D. C. Jackson and H. P. Hammond, who have been very effective workers in creating this organization. Many of you have been appointed to committees. General Rees will make a report.

For the effective promotion of engineering education it is important that this Society coöperate closely with other societies and organizations. A notable instance of this is the report of Professor H. H. Higbie's Committee on Research. This work, begun by Dean Seaton while chairman of the committee, was completed by Professor Higbie and was then submitted to Dean J. W. Barker, who is working in the same field for the National Research Council. We are in hopes through this arrangement to secure the printing of the completed report—at the same time it has become very useful.

In addition to the regular sessions of the Society at this meeting there are eleven conferences devoted to discussion in particular fields. Some of these are being held in conjunction with other engineering societies. Some have been held regularly for several years. The work of these conferences has added greatly to the interest of the annual meetings.

It would be impossible for the Secretary to enumerate in his annual report all the excellent work that is being done in engineering education but among these are the T-Square Page appearing each month in the JOURNAL and edited by F. G. Higbee, Iowa State University; the Machine Design Clearing House by F. L. Eidmann, Columbia University; English under the leadership of Miss Sada A. Harbarger, Ohio State University; the Division of Mechanics under the chairmanship of A. E. Norton, Harvard University; and many others.

The Secretary has attended, as the representative of the Society, meetings of the American Engineering Council, and as a member of the Executive Committee of the American Council of Education.

Many junior colleges are now giving preliminary work in engineering education. The effect of this has been recognized by the Council and by the Society in the appointment of a Committee on Junior Colleges and by the holding of conferences at Corvallis and at this meeting. I understand that there will come from this Committee a recommendation that some type of membership in this Society be provided for such institutions. It is quite probable that this will come before the Council during the present session.

The Secretary's office has been the recipient of many letters asking for information concerning what takes place in engineering schools during and following an economic depression. I believe it would be wise for the Council to authorize an exhaustive study of the effects of the depression upon the engineering colleges. Among other things the study would cover

1. Courses that have been discontinued in engineering schools because of lack of funds.
2. Changes in faculty personnel.
3. Curtailment of research.
4. Curtailment of graduate work.
5. Placement of graduates.
6. Admission requirements.

ORIGIN OF THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION *

By ARTHUR N. TALBOT

Professor of Municipal and Sanitary Engineering, Emeritus, University of Illinois

The Society for the Promotion of Engineering Education was the outgrowth of Division E, Engineering Education, of the World's Engineering Congress held in Chicago July 31 to August 5, 1893.

In connection with the World's Columbian Exposition of 1893 a series of congresses on important branches of knowledge and industry was instituted by the World's Congress Auxiliary of the Exposition, of which Mr. Charles C. Bonney was president. One of the most successful of these congresses was the International Congress of Engineering. Dr. Octave Chanute, a prominent civil engineer of Chicago, who later contributed much towards developing the principles of heavier-than-air flying machines and gave substantial aid to the Wright Brothers in their early efforts in aviation, was responsible in large measure for the conception of the engineering congress and for the great success of the whole enterprise. He acted as presiding officer of the general meetings, and gave general direction to the conduct of the congress. The various divisions included Civil Engineering, Mechanical Engineering, Mining Engineering, Metallurgical Engineering, Military Engineering, and Marine and Naval Engineering and Naval Architecture, as well as Engineering Education. The chairmen of the first three divisions were the presidents of the national engineering societies, with Major Comly chairman of Military Engineering and Admiral Melville chairman of Marine and Naval Engineering and Naval Architecture. At the many sessions of the divisions a large number of valuable technical papers were presented, many of which were important contributions to engineering knowledge. The attendance of engineers who were prominent in their various lines was especially gratifying to those having charge of the congress. Leading engineers from the principal countries of Europe and other parts of the world were present and participated in the discussions. As a whole, the International Engineering Congress

* Presented at the 40th Anniversary Meeting, S. P. E. E., Chicago, June 26–30, 1933.

was most successful in its attendance, its proceedings, and its influence on the engineering profession, and also on the world relations of engineers.

As a member of the General Committee of the World's Congress Auxiliary on Engineering Congresses, Ira Osborn Baker, Professor of Civil Engineering in the University of Illinois, in some of the preliminary discussions of plans for the congress suggested to Mr. Bonney and Mr. Chanute the desirability of including in its scope a section on engineering education, and accordingly Division E, Engineering Education, was formed with Professor Baker as chairman of the Special Committee for Division E. It is significant that Professor William Cawthorne Unwin * of London, England, in his remarks at the closing general session of the congress, speaking as the representative of the engineers of Great Britain, after referring to engineering as a scientific profession that was constantly gaining in dignity and importance, said that he could not help remarking that this was the first engineering meeting within his recollection at which there had been a recognition of engineering education as being an important subject; that not only had it been recognized but it had been given a place equal in importance to the great branches of engineering; that the United States was in a favorable position having through the munificence and public spirit of its citizens had magnificent endowments and appropriations for engineering education so that it was solving a most interesting problem by taking an entirely new step in the work laid out for the engineer by recognizing the necessity for a foundation of scientific education for engineers. It will be recalled that at that time even in the United States engineering education did not hold the high place as preparation or as an essential to the practice of the profession that it occupies at the present day. The formation of Division E must therefore be recognized as an important and significant step in the history of engineering education in this country.

Notwithstanding the late formation of Division E and the imperfect opportunities afforded for making public announcement of its program, a large and representative number of engineering teachers gathered for its sessions. On the invitation of Professor Baker, sixteen engineering teachers had prepared papers, though

* William Cawthorne Unwin, a distinguished professor and engineer of London, England, died March 17, 1933, at the age of 94 years. For thirty years he was Professor of Engineering at Central Technical College of the Guilds in London. He was a past president of the Institution of Civil Engineers and of the Institution of Mechanical Engineers and an honorary member of the American Society of Civil Engineers and the American Society of Mechanical Engineers.

several others had found themselves unable to accept the invitation. Among the subjects of the papers presented may be mentioned "The Ideal Engineering Education," "Present Favorable and Unfavorable Tendencies in Engineering Education," "Comparison between American and European Methods in Engineering Education," "The Equipment of Engineering Schools," "Requirements in Mathematics for Engineering Education," "The Teaching of Graphical Methods," "Original Research by Students," "Training of Students in Technical Literary Work," "Vacation Work," and "Graduating Theses." To give the names of authors of papers and of those participating in the discussions would be something like calling the roll of the engineering teachers of forty years ago, many of them pioneers in engineering education in this country. Some names may be mentioned as among the most active at the meeting: C. Frank Allen of Massachusetts Institute of Technology, Storm Bull of University of Wisconsin, William H. Burr of Columbia University, Rolla C. Carpenter of Cornell University, Samuel B. Christy of University of California, Henry T. Eddy of University of Minnesota, John Goodman of Yorkshire College, H. S. Hele-Shaw of University College of Liverpool, D. S. Jacobus of Stevens Institute of Technology, John B. Johnson of Washington University, Olin H. Landreth of Vanderbilt University, Gaetano Lanza of Massachusetts Institute of Technology, Charles D. Marx of Stanford University, represented by L. M. Hoskins of the same institution, Mansfield Merriman of Lehigh University, Dwight Porter of Massachusetts Institute of Technology, Palmer C. Ricketts of Rensselaer Polytechnic Institute, Stillman W. Robinson of Ohio State University, Henry W. Spangler of University of Pennsylvania, George F. Swain of Massachusetts Institute of Technology, Robert H. Thurston of Cornell University, DeVolson Wood of Stevens Institute of Technology, Robert S. Woodward of Columbia University.

The sessions of the Engineering Education Division were presided over by Ira O. Baker as Chairman of the divisional committee, and C. Frank Allen of Massachusetts Institute of Technology acted as secretary. The seventy or more teachers in attendance voiced the sentiment that the papers and discussions were of real value and that the coming together of the body of engineering teachers was an occasion and an opportunity that would constitute a milestone in engineering education.

The general feeling that the congress of engineering teachers should be continued in a permanent organization was crystallized through the appointment of a committee by the chairman consisting of Mansfield Merriman, J. B. Johnson and C. Frank Allen, which reported a constitution and nominated officers for the So-

ciety for the Promotion of Engineering Education.* DeVolson Wood was made President, Samuel B. Christy and George F. Swain Vice Presidents, John B. Johnson Secretary, and Storm Bull Treasurer, and others were made members of the Council of the new-born society. The membership was originally composed of all who registered themselves as in attendance on the Division of Engineering Education of the International Engineering Congress, and the Secretary reported that it was a remarkable fact that nearly all of those registered, 63 in number, qualified as members.† The proceedings of the 1893 meeting (Division E, Engineering Education of the World's Congress) were published in book form by the new Society with the blue binding that continued so many years as the official color, and constituted Volume I of the Proceedings of the Society for the Promotion of Engineering Education.

The first annual meeting of the Society for the Promotion of Engineering Education was held in Brooklyn, New York, in August, 1894, in connection with the meeting of the American Association for the Advancement of Science. Over one hundred were present and the membership was increased to 156. Under "Objects and Opportunities in Volume II of the Proceedings the following statement was made: "Although the organization includes in its membership a large number of the leading educators in the engineering schools of the country, it is desirable, in order that the Society may complete its mission, that practically all the professors of engineering in this country, as well as those practicing engineers who are interested in the development of our engineering schools, should become members of the Society and contribute to its Proceedings." The following further statement was made: "The engineering schools of America are still in a formative stage, with a prospect that many of them will become at an early date very nearly the ideal engineering schools.

"The shaping of the technical education of a nation is a work which may well call for the continuous service of our ablest educators, and the advantages of participating in the work should ac-

* Another organization, the Association of Teachers of Mechanical Engineering, of which Professor Stillman W. Robinson was president, had called a meeting for one of the days of the Congress and coöperated in the formation of the new Society.

† The seventy names given in Volume II of the Proceedings as holding membership in 1893 included in addition to those already named as actively taking part in papers and discussions a large number of prominent teachers, who have since contributed distinguished service to engineering education. Among them were seven from outside the United States. At least twenty of those in attendance are still living. Doubtless many of these charter members would join with the writer in saying that the Congress was the beginning of friendships with a very large part of the seventy which through years have continued to give pleasure and satisfaction.

crue to each and every school, college, or university in the country, through its professors and teachers who are members of the Society which is primarily charged with this work. There is now little question that this Society will have a great and lasting influence in shaping the development of our engineering schools, and while the teachers of our leading technical schools have to date shown the greatest interest in this work, the greatest advantages are likely to be reaped by those members who represent the newer and smaller schools, the principal development of which is still in the future."

Keen as was the foresight of the founders of the Society and important as they felt the destiny of the Society to be, they could little foresee the great growth and development in engineering education in the following forty years—growth in numbers of students and faculty, in equipment, in methods, in public interest, in contributions to engineering science and to the developments in engineering practice, or even to the recognition of the relations between engineering education and the engineering world, or to the recognition of the engineering teacher and engineering education by the engineering societies, or to the recognition of the need and value of high ability and fitness in the engineering teacher. It is not within the scope of this address to recount the accomplishments of the Society for the Promotion of Engineering Education in influencing the development of engineering education but it is pertinent to say that the Society has had a most potent influence on the engineering school and its teachers in the forty years since 1893.

In closing this account of the origin of the Society, I hope it will be thought appropriate to express the view that because of the initiative of Professor Baker in the formation of the Division of Engineering Education of the World's Engineering Congress of 1893 and his activity in developing a program of interesting topics with prominent engineering teachers as authors—an occasion and a program which brought together a large body of interested educators ready to join into a movement for a permanent organization of engineering teachers—the man and teacher Ira Osborn Baker deserves to be recognized as the founder of the Society for the Promotion of Engineering Education.

PROMOTION OF ENGINEERING EDUCATION IN THE PAST FORTY YEARS *

By H. P. HAMMOND

Professor of Civil Engineering, Polytechnic Institute of Brooklyn

The title that has been given me for this paper is obviously taken from the name of the Society. I have never known what was in the minds of those who chose that name, nor, until I came to this convention, have I been able to learn who proposed it. From what Professor Talbot has told me in the past two days, it seems probable that it was Mansfield Merriman who was, in part at least, responsible for its adoption.

The active word in our name is "Promotion," which is sometimes associated with the objectionable term "promoter." If anyone cares to learn the appropriateness of the word "Promotion," I suggest that he consult a dictionary. There he will find the verb "promote" defined: "To further the growth, development, progress or establishment; to help forward; to further, advance, encourage." I submit that this is as nearly perfect a designation of the aims and purposes of this Society as could be found.

It is for me, then, to describe how engineering education has been *promoted* in the past forty years. It is a staggering job. To accomplish it adequately would require the writing of a history of that complex organism that we call engineering education. It would entail a discussion of social and economic changes; it would include developments in the arts and sciences relating to our field; it would involve the accomplishments of hundreds of men. I shall not presume to attempt it. All that I can do is to deal with some of its aspects and to give general impressions; not accurate data and details. Further, I am suffering under the limitation of knowing nothing of engineering education at first hand prior to 1905. I wonder if your impressions of events are the same as my own: Anything that happened before we had personal knowledge of it seems to have occurred a long while ago—to be dim and remote; anything that we relate to our own experiences seems to be quite recent history. My impressions of engineering education in '93 are therefore not trustworthy, though I have consulted some of our

* Presented at the 40th Anniversary Meeting, S. P. E. E., Chicago, June 26–30, 1933.

founders and have studiously read the early volumes of our proceedings.

Fortunately, these early volumes give what seems to be a clear impression of the state of engineering education in 1893, lacking in statistical data, perhaps, but certainly a vivid and an interesting picture. A reading of Volume I, the transactions of the organization meeting here in Chicago, and of Volume II, the first annual meeting, held at the Polytechnic Institute of Brooklyn, in 1894, will richly repay the time and effort.

The chief impression one obtains from these volumes is the unchangeableness of the fundamental aims and ideals of engineering education. He even finds the same expressions employed then that we use to-day and consider, perhaps, to be original and new. One finds the same immediate problems discussed with which we are now confronted.

Many illustrations might be quoted from these early discussions to aid in forming a conception of engineering education forty years ago. Perhaps one, as indicative as any other, is the general level of admission requirements. A paper by Professor Frank Marvin, of Kansas, presented in 1894, summarizes the admission requirements of 77 schools. He groups these in two classes—Class A, which includes 43 better known and higher standing colleges of engineering; and Class B, which includes 34 of less well-known and lower standing. The list is not complete, but it is representative. The admission level is indicated clearly enough by the fact that some schools require penmanship, reading, spelling, and arithmetic, among other subjects, for admission. This should not be taken to imply that engineering education had not reached a sound and vigorous development by 1893, but it does indicate that we have passed a good many milestones since then.

Engineering education in the 90's had achieved a recognized status on the campus and, while it was not universally admitted to be an entirely legitimate division of higher education, it was nevertheless pretty strongly entrenched. The early prejudices of the classicists against science and engineering had not completely passed away; witness the fact that as late as 1903 one of our members, a graduate of Worcester Polytechnic, was refused admission to the University Club of Brooklyn on the grounds that he was a graduate of a polytechnic institute and not of a college.

On the other hand, the prejudices against engineering graduates in many lines of employment had by no means disappeared and the young engineer from college often had to overcome the opposition of the "practical" man. I know this was true as late as 1909, for some of my classmates who went to work with the railways in that year had to combat the prejudice of the practical engineer, the

self-taught draftsman, and the supervisor who had risen from the ranks. I suspect that this was true also in manufacturing. The graduate is now welcomed where he was then grudgingly admitted; furthermore, many fields are now open to him that did not exist at all in the 90's.

The engineering teacher, however, had no misgivings as to the status or the future of his work. One has but to read De Volson Wood's presidential address in 1894 to be convinced of this. It is a noteworthy fact that many of the founders of this Society were quite young men. One need merely read the list and count up ages to find that a majority of the members in 1894, such as Adams, Allen, Anderson, Breckenridge, Burr, Cooley, Foss, Jackson, Magruder, Marburg, Marston, Raymond, Ricketts, Sackett, Swain, Talbot, Turneaure, were in their 20's or 30's or at most in their early 40's. It is no wonder that this Society began with a vigorous start and, from the day of its establishment, began to exert the profound influence it has exercised in engineering education.

The advancement that has come since the 90's has not been in fundamental status, in primary purpose, or, in general, in content or method. It has been a broadening, an enrichment, a diversification, and a steady enhancement of standards, accompanying a pronounced growth in magnitude.

This paper is not to be a laborious statistical summary, but in the paragraphs that follow I hope to indicate in general terms at least some of the more obvious developments and changes. Perhaps in some instances I shall be able to indicate causes, and even effects.

Growth in Magnitude

Let us start with the growth in magnitude of engineering education. The exact number of schools and of students in '93 probably cannot be determined. The Office of Education states that there were 9,517 students of technology in this country. I doubt whether this is an inclusive figure. There were about 100 engineering schools then and a guess would place the number of students somewhere near 12,000 or 13,000. One thousand is mentioned in the Proceedings for 1894 as the number of graduates per year. Since then enrolments have grown to about 65,000 in degree-conferring courses alone and the number of colleges has increased to nearly 160. Engineering has become the largest division of higher education, excepting only Liberal Arts and Teacher Training. By 1893 virtually all of our present leading engineering colleges had been established, but it is a very interesting and significant fact that over three fourths of them were not

yet twenty years old. Numerically, enrolments have increased five-fold, while the number of institutions has increased only about 50 per cent. It is fortunate that this has been the case.

Of graduate students there were virtually none in 1893. Now there are about 4,000. Almost as many advanced degrees were conferred in 1933 as there were first degrees in 1893.

There were no junior colleges then; now there are over 400, and 150 of these offer work in engineering.

The Curriculum

I have not been able to learn the number of curricula offered in '93, but there were considerably fewer than we have to-day. All five of our present major curricula had been established. Civil, mining, and mechanical engineering were the "Big Three" of those days; but electrical engineering, which was in its youth, was rapidly moving forward to an important and independent position. In some schools it was still taught in the Physics Department and in others was subordinate to Mechanical Engineering. In general it had not achieved a major status, though this was to come within ten years.

The first course in chemical engineering was announced by the Massachusetts Institute of Technology in 1888, the first program of this type to be established in this or any other country. The second curriculum in chemical engineering was offered at Michigan in 1895. While it may, therefore, be strictly accurate to say that chemical engineering had been established when this Society was founded, actually it had hardly even begun.

During the past forty years a curious paradox has developed in engineering education. In one direction there has been much greater diversification of curricula (there are now 80 different curricula and options in engineering offered in this country); a movement which, to the outsider, might seem to be an attempt to match each new development by the establishment of a corresponding curriculum. In the opposite direction, and particularly in the past two decades, there has been a distinct movement toward consolidating and simplifying engineering education through the offering of broader, more fundamental, and more general types of programs. To us in engineering education it is perfectly apparent that the second of these two tendencies is the real and basic one. The former is more often mentioned by critics as an evidence of specialization and an attempt to teach everything. As a matter of fact, there is less specialization in undergraduate programs than there was twenty-five years ago. The curriculum itself has undergone important changes. The trend toward the introduction of

more and more subjects, and toward a higher and higher degree of particularity seems to have reached its peak at about 1915. Since then, and particularly since the reports of the Board of Investigation and Coördination were published, there has been a distinct movement toward simplification, fewer subjects, and broader curricula. I recently had striking evidence of this in the case of an institution that had not changed its curriculum materially since 1924. Whereas in that year 20 colleges had greater numerical requirements for the degree, in 1933 only four colleges exceeded its requirements.

Physical science, mathematics, economics, and almost all of the humanistic subjects except foreign languages, have increased in amount relative to technological subjects. Shop work and drawing, as well as modern foreign languages, have suffered to a marked degree.

In a word, while the number of curricula has increased steadily, the general trend has been in the direction of less specialization. *Ad-hocness* is on the wane in engineering education.

The Length of the Curriculum

It is interesting to note in the early Proceedings that the length of the curriculum was a moot point. Professor Burr in his paper "The Ideal Engineering Education" makes a plea for the admission of more students having a preliminary liberal arts education. This question seems, indeed, to be a perennial one. Coupled with it is the problem of the unified versus the divided engineering program.

Since 1893 a number of institutions have experimented with longer curricula, and some have permanently adopted them. These schools do not include Dartmouth, where six-year and five-year curricula have been in operation continuously since 1871. Harvard placed all of its engineering courses on a graduate basis in 1906, but restored the four-year course in 1919; Columbia adopted its six-year program in 1914; Missouri required three years of liberal arts work for admission to engineering in 1911, but discontinued this plan in 1915; Minnesota at one time offered a five-year curriculum; South Carolina, C. C. N. Y. and other institutions have also experimented with longer curricula.

Related to these are the plans for the divided curriculum, such as that adopted by the University of Pennsylvania about ten years ago when the four-year program was divided into two parts, the first two years being given exclusively in the college of liberal arts.

In every instance the effect of these plans has been a sharp drop in enrolments. Observation of these trials has made other institutions wary of adopting them. This factor, coupled with the recom-

mendations of the Board, which have had a marked influence, have tended to fix four years pretty firmly as the norm for the undergraduate program.

Graduate Courses

The rapid development of graduate courses in engineering has taken place chiefly in the past fifteen years, though the beginnings of post-graduate study go back much farther. No definite date can be set for the first offering of graduate courses in engineering, but it is probable that the real start was made just about simultaneously with the founding of this Society. Professor Dugald C. Jackson, then of the University of Wisconsin, began offering graduate work for the Master's degree in electrical engineering in the early 90's, and there was also some work for the Doctor's degree offered at Wisconsin at about that time. A graduate program in electrical engineering was offered by the Lawrence Scientific School of Harvard in 1893. Work for the Master's degree at the Massachusetts Institute of Technology was started in civil engineering in 1894; chemical, mechanical engineering, sanitary and electrical engineering, following within the next ten years.

Graduate study has made its most rapid progress since 1920. From 1921–22 to 1930–31 the increase in enrolments in electrical engineering was nine-fold, in mechanical engineering seven-fold, and in chemical engineering six-fold. In all branches combined it was eight-fold, a truly remarkable growth. Progress was not simply numerical, however, but went much deeper in quality and effectiveness.

In early days graduate work was not only limited to comparatively few students, but in many instances was virtually a fifth-year of undergraduate instruction both as to subject matter and fundamental status and method. Independent—or perhaps I should say guided—investigation and research by the student was not nearly so firmly grounded as it is to-day. I think it is accurate to say that it is in this particular that graduate study has made its greatest progress in the past fifteen years. In fact, I believe that it is in this direction that engineering education has been most effectively promoted in recent years, for the effect of independent investigation is felt throughout all phases of college work; the effect on the faculty, in particular, is salutary.

Part-Time Courses

An interesting development in post-graduate study is that which has taken place in a few urban centers in coöperation with industries or on a part-time basis. Union College, Massachusetts Institute of Technology, the University of Pittsburgh and Colum-

bia University provide, through coöperation with the General Electric and Westinghouse Companies and the Bell Telephone Laboratories, post-graduate courses for men employed by those concerns. The University of Pennsylvania and the Polytechnic Institute of Brooklyn provide evening courses leading to the Master's degree, and in one curriculum to the Doctor's degree. The University of Wisconsin provides graduate courses for metallurgical engineers employed in Milwaukee. There has been a phenomenal growth in enrolments in these courses, accounting in part for the rapid increase in the total number of graduate students. The institutions mentioned have in all upwards of 500 part-time graduate students who are regularly employed during day hours.

Another variant of full-time instruction is supplied by evening undergraduate engineering courses. They were first provided at the Polytechnic Institute of Brooklyn in 1904 and at present are offered by institutions in New York, Washington and Pittsburgh. In all, about 4,200 students were enrolled this year in evening engineering courses leading to the Bachelor's degree.

Engineering schools and colleges have greatly extended their services in the past forty years through the offering of courses not leading to degrees in the evening, in which some ten thousand students are enrolled; through various short-term and extension courses, in which there are approximately 2,500 enrolments; and through other forms of extra-mural and correspondence instruction. The entire body of students securing some measure of benefit on a part-time basis from the facilities of engineering colleges is close to 20,000. Surely this is a significant phase of engineering education.

Non-Collegiate Engineering Schools

The foregoing paragraphs refer to engineering education as conducted by collegiate institutions. In parallel with this division of our field there has existed in this country for over one hundred years a group of institutions that provide technical education not leading to degrees. Institutions of this type antedate engineering colleges themselves. The Mechanics Institute, New York City, had its origin in 1820; the Gardner Lyceum, of Maine, in 1822; the Maryland Institute, of Baltimore, in 1825; the Ohio Mechanics Institute in 1828. Rensselaer Polytechnic Institute, founded in 1824, was a non-collegiate institution in the early years of its existence. In 1893, then, many of the most prominent and strongest of these institutions were in existence. Pratt Institute, of Brooklyn, which is often taken as the exemplar of the group, had been established six years previously, and several of the others such as Wentworth, Dunwoodie, and the David Rankin School, followed soon afterward.

I venture to say that the needs of this country for an intermediate type of technological education were no different, essentially, in 1893 than they are to-day. Forty years ago the technical institutes, as they have been called, were also as diversified in method, purpose, and instruction as they are to-day. Generally speaking, each has been a free lance, influenced chiefly by the ideas and by the terms of the bequests of their founders. They have been influenced also, of course, by local industrial, economic and educational factors; but they have been largely free from the influence of group action, as is the case so strikingly in collegiate engineering education. I believe that the task of fitting their programs into the educational scheme of the country has been very much more difficult for the non-collegiate schools than it has been for the engineering colleges.

America "went collegiate" many years ago and the general, unthinking public attitude is that it is the degree or nothing in higher education. The technical institute has had a difficult task to keep its identity and its aims clear in face of this attitude. Even those established on a sound and adequately financed basis have found it difficult and still find it difficult to continue. Many of them, under some stress of circumstance, or some change in personalities, have become engineering colleges. It is to the lasting credit of those that now occupy this field that, in the face of difficulties, they have continued to supply a most important educational function in this country.

At this point it may be well to say that proprietary schools, operated chiefly for the profit of the proprietors, have never been, and do not now promise to be, an important factor in engineering education, or one whose consequences are much to be feared.

The Coöperative System

The most noteworthy single development in engineering education in this country since 1893 was the establishment, in 1906, of the coöperative system. We owe the establishment of this plan to the vision, the initiative, the resourcefulness, and the energy of one man, Dean Herman Schneider.

The story of the inception of the coöperative plan forms one of the most fascinating chapters in the history of engineering education: How Schneider first conceived the idea in 1902 as a result of his own experience as a student working part-time in an architect's office and of his effort to find an answer to the problem of relating education to actual experience; how the idea flashed upon him one evening as he crossed the Lehigh campus, heard the whistle of the Bessemer converter, and thought of the steel plant

as a million dollar laboratory for college students; how he tried first to interest his colleagues, then the industries; how when the American Bridge Company was on the verge of adopting it, the establishment of the Carnegie Institute of Technology foiled the plan; how he moved on to Cincinnati and finally after four years of struggle succeeded in having the system adopted there on trial.

From small beginnings at Cincinnati, the coöperative plan spread rapidly. In 1909 it was adopted at Northeastern, in 1910 at Pittsburgh, in 1912 at Georgia Tech, in 1914 at Akron, and in 1915 at the University of Detroit. Between 1919 and 1926 at least one institution adopted it each year, on the average. Three years ago, no fewer than 20 institutions had the coöperative system in operation, though one or two have since discontinued it temporarily because of economic conditions.

At the present time more than one tenth of all our institutions offer coöperative courses and three years ago more than one tenth of all engineering students in the country were studying under the coöperative system. Whatever the merits of the coöperative plan may be, and it has much to recommend it, it is certain that it has been the most important single innovation in engineering education during the life of this Society. It deserves to be ranked with the growth of graduate study and research, the introduction of courses in management and administration, and the increased attention to economics as one of the major developments in our field.

Research

Research activities in the engineering colleges were meager in 1893. They did not exist on an organized basis as we have them to-day; there were no engineering experiment stations. There was research, of course, but it was conducted chiefly by individual teachers on an individual basis. I am not able to trace the advent of research in the colleges, but I can cite at least one instance of systematic research that was begun soon after 1870. This was a program of combined instruction, commercial work and research in the properties of engineering materials carried on by Robert H. Thurston at the Stevens Institute of Technology.

The first organization of research under a formal agency that I have been able to discover was the establishment in 1903 of the Engineering Experiment Station at the University of Illinois under Professor L. P. Breckenridge, one of the founders of this Society. The station at Iowa State College was also established during the winter of 1903–04. The Purdue station, the third of the big three in this field, was not established until 1917, under Dean C. R. Benjamin, though W. F. M. Goss began his famous

work on the locomotive—the antecedent of the Experiment Station —at Purdue in 1892. At the present time a majority of the land grant and state universities have formally organized engineering experiment stations, though a number of them exist chiefly on paper. A number of other colleges conduct research on an organized basis, the most conspicuous illustration of which is doubtless the Massachusetts Institute of Technology, through its Division of Municipal and Industrial Research and its Division of Industrial Coöperation and Research.

It would be difficult to overemphasize the importance of the engineering experiment stations in this field. These have not enjoyed the great subsidies that have been made available to agriculture, but they have nevertheless done much to promote research activities in engineering. Under the stimulus of the experiment stations and of institutions conducting research on other bases, research enterprises have grown rapidly until in 1924–25 they involved expenditures of nearly a million and a half dollars a year, and the activity of full-time research staffs of 866 persons.

Employment and Training of Engineering Graduates

One of the striking developments during the life of this Society has been the change of attitude of employers toward engineering graduates and the methods used to recruit and train them. The law of demand and supply has been in operation. The electric manufacturing, power, and communications companies have led this movement, since a great expansion of technically trained personnel has been required to keep pace with the phenomenally rapid growth of the electrical industry. This entire industry has, to a considerable extent, been an industry of young men. It owes its growth, of course, to developments in the science and technology of electricity and to basic industrial conditions, but it is fair to say that the industry is a monument to the engineering graduates of our colleges.

In 1893 there was no organized recruiting as we have known it in recent years. The first instance I have been able to find of the employment of graduates direct from college by solicitation on the part of the employer was in 1893, by the American Bell Telephone Company, of Boston. In a few years the operating companies of the Bell System began to recruit, especially the Bell Telephone Company of Pennsylvania. Shortly after '93 the Western Electric Company also began to recruit graduates.

In the General Electric Company, until 1897, students were required to apply and no canvasses were made of the colleges. From 1897 to 1913 a number of colleges were visited each year, but at

the other schools the professors were depended upon to make recommendations. Since 1913 the company has endeavored to interview all graduates offered employment.

The Westinghouse Company also started to recruit and train graduates within ten years of its organization in 1886. Employment at first was by the "over-the-counter" method. In 1902, however, the Superintendent of Employment, in order to meet the needs of a rapidly expanding personnel, found it necessary to visit a few colleges to secure sufficient graduates.

A notable advance in recruiting methods was made in the Bell System in 1920 chiefly through the work of W. E. Wickenden. It was his effective studies of the educational system of the telephone companies that led to his choice as Director of our own investigations.

By 1927 recruiting had reached truly remarkable proportions, the Bell System alone having employed as many as one thousand graduates in a single year. During the boom years graduates of the important colleges were often offered several positions—in some instances six or eight—from among which to choose. While wholesale recruiting has not been an unmixed blessing, I venture to say that we should be glad to see industrial conditions restored to the point where the graduate could again have the facts concerning opportunities laid before him by representatives of the companies and to select that one which seemed best to fit his abilities.

Paralleling this development, there has been the growth of post-collegiate training programs. I believe that this has constituted a really notable contribution to the general field of engineering education, considered in its broadest scope. At first the aim was merely to add experience to the knowledge the student brought to the industry from college. This was followed by instruction accompanying the experience to aid the student better to understand the things in which he was working and to encourage him to systematic reading and study. Then followed advanced theoretical instruction. In the Westinghouse Company, Benjamin G. Lamme, and in the General Electric Company, Robert E. Doherty, were in charge of these advanced courses. The Bell Telephone Laboratories, also a pioneer in post-scholastic training of engineers has long maintained educational and training programs. The Educational Department of the Western Electric Company was organized in 1900 under J. W. Dietz. In the Westinghouse Company, largely through the initiative of Charles F. Scott, there was established, in 1902, the Westinghouse Club, primarily an educational adjunct to the experience courses for graduates employed in the works.

All of these developments, taken together, constitute a significant phase of the history of engineering education.

Relationship of Engineering Education to the Profession

In preparing this paper I was interested to find how often the year 1893 recurred in relation to important events. For example, in connection with the relationship of engineering schools and the organized profession of engineering, I find that in 1893 and 1894 two significant papers were presented before conventions of the American Society of Mechanical Engineers. One was by its first president, Robert H. Thurston, which was delivered here at Chicago in 1893. This was a comprehensive report on technological education in the United States, tracing its social, industrial and economic relations to progress. The second paper, also by the president of the A. S. M. E., Eckley B. Coxe, and devoted to engineering education, was delivered at Montreal in 1894. Quite evidently, in one society at least, and it is safe to assume in the others as well, interest in engineering education was as vital as it is to-day. In other ways, however, the attitude of the profession toward education has undergone marked changes. It was not until recently that teachers were eligible, as such, to full membership in the American Society of Civil Engineers. A teacher might be a member, but it was by virtue of his outside professional experience; teaching was given no weight. To-day the reverse is the case, and many recent presidents of the national societies have been teachers. Our former president, Dean Potter, is president of the American Society of Mechanical Engineers at this moment.

There has been a distinct change also in the weight given to an engineering degree in the qualifications for membership. The American Society of Civil Engineers to-day counts the Bachelor's degree as the full equivalent of four years of engineering practice.

No single factor has been more important in bringing about closer relationship between the schools and the societies than have been the student chapters and branches. These were first organized in the American Institute of Electrical Engineers, in 1902, during the presidency of Charles F. Scott, who proposed these chapters and exercised the chief influence leading to their establishment. Branches were established by the American Society of Mechanical Engineers in 1908, and by the American Society of Civil Engineers in 1920. At present there are 360 chapters and branches of the founder societies, with approximately 11,000 members. It would be difficult to overestimate the importance of the chapters in bringing about closer, friendlier and more coöperative relations between the profession and the schools. Engineering education stands in Professor Scott's debt in many ways, but in none more so than in his broad vision in initiating this movement.

Coöperation between the schools and the societies has not, of

course, been limited to student branches and chapters. In 1907, through the initiative of Dugald C. Jackson, a joint committee on engineering education was established by the national engineering societies. This led later, in 1914, to the investigation conducted under the auspices of the Carnegie Foundation for the Advancement of Teaching and to the Mann report of 1918. Throughout the Society's own investigation of 1924 to 1929, all five of the national societies coöperated actively. All of the societies have sponsored and supported sessions of the Summer School for Engineering Teachers, in two instances accompanying the coöperation with substantial contributions of funds. All of the Founder Societies now have committees, sections or divisions on engineering education.

Engineering Foundation, through its Director, Dr. Alfred D. Flinn, has been a strong and effective supporter of engineering education, furnishing advice and counsel, assistance in securing funds for our enterprises and continuing as one of the staunchest supporters of the summer schools.

Recently, a further liaison has been established with the profession through our membership in American Engineering Council.

The latest and perhaps the most significant development in the relationship of the profession and the colleges is the establishment, last year, of the Engineers' Council for Professional Development. This body represents this Society, the five national engineering societies and the National Council of State Boards of Engineering Examiners. This agency, under proper leadership and with necessary support can go far not only to solve a number of perplexing immediate problems but it can also so cement the structure of professional engineering into an articulated whole as greatly to enhance its position and its usefulness.

The Influence of Text Books

To turn now from external to internal matters I should like to trace some of the factors that have influenced the evolution of our methods of teaching. I do not hesitate to express the belief that textbooks have exerted a profound influence upon our work. It is thus that our great teachers have chiefly influenced the methods of others.

By 1893 the literature of engineering education was fairly abundant. Not only did the teacher have available the works of Rankine, Weisbach and other foreign writers on mechanics, as well as the works of Faraday, Carnot and others, but there was also an abundant American literature. Merriman, Church, Burr, Lanza, Johnson, Baker, Peabody, Thurston and many more had written their standard texts which were in wide use in the colleges.

I think we often underestimate the influence that textbooks have had on courses of study and methods of teaching. It is interesting, for example, to note how many courses bear the same names as the textbooks on which they are based. In my own field, what used to be called Water Supply Engineering in the days when Folwell was the standard work became Public Water Supplies under the influence of Turneaure and Russell. The same is true in mechanics; when Church's book was widely used, or Burr's, one was likely to find a comprehensive course in applied mechanics. Under the influence of Merriman's works this course was subdivided into analytical mechanics, mechanics of materials, and hydraulics. If anyone wishes a still more striking illustration of the effect of textbooks on a curriculum, he has but to consider the influence of Walker, Lewis and McAdams, for years the "bible" of the teacher of chemical engineering; or the influence of French's "Engineering Drawing" not only on methods of teaching, but also, be it said, on the books of other authors.

Industrial Engineering and Management

One of the most significant developments of the past forty years has been the introduction of Management in the training of engineers. Coupled with this has come recognition of the personnel element as a part of our work. As J. W. Roe points out—

> Up to thirty or forty years ago the engineer was almost invariably a technical man, usually working for others and characteristically gun-shy of economic and industrial responsibilities and inclined to avoid them wherever possible.

Curricula even in my own day in college included almost nothing of management or administration. A change of attitude began at about the turn of the century; since 1910 the introduction of management and administration has been rapid. Many of these changes may be traced to the influence of the American Society of Mechanical Engineers which has had a leading part in furthering recognition of this phase of engineering.

The first course in Management in an engineering college in this country appears to have been offered by Hugo Diemer at the University of Kansas in 1902. Dean Kimball established a similar course at Cornell in 1904. Diemer subsequently moved to Pennsylvania State College, and it was there that he started the first curriculum in industrial engineering in 1908. Other colleges to follow in this movement were Purdue, in 1910, the Carnegie Institute of Technology, in 1912, and several others within the next five years.

Thirty-five curricula leading to degrees in industrial engineer-

ing, in engineering administration and the like are now offered. More than 600 students are now graduating from these courses each year.

There is still much uncertainty as to the aims, purposes, and content of these curricula. Their names alone are an index of this diversity: Industrial engineering, industrial management, administrative engineering, commercial engineering, business and engineering administration, management engineering, engineering shop administration are some of the titles given to these courses. The curricula themselves range all the way from those that are chiefly scientific and technical in content, with a small admixture of business, to those almost wholly administrative with a small amount of science and engineering. The element of management and administration has undoubtedly entered engineering education to stay, and it is no doubt well that it has. In time, and perhaps in not a long time, these courses will become more unified, more definite in aim, and more substantial in their content and method than they are now.

Engineering Economics

Related to management and administration is the teaching of economics. The course in general economics has always been provided by some engineering colleges. In many instances work in economics for the engineering student is still limited to the course in formal or classical economics, which, I think, has a definite place in the training of every engineer, if properly presented.

Courses in "Engineering Economics," however, have entered our curricula but recently. Stevens Institute has been a leader in this field. In 1897 under President Morton, lectures on the business aspect of engineering were first given by Alexander C. Humphreys, whose name has been given to the chair in economics of engineering in that institution. The department of Business Engineering was established during Humphreys' presidency at Stevens in 1903, becoming the Department of Economics of Engineering in 1909. At present, Stevens has four full-time teachers of economics, economics of engineering and related subjects in a faculty of 60 and a student body of about 500.

Stevens Institute has not been alone in pioneer work in the teaching of engineering economics. The work of Webb at Pennsylvania, Raymond at Iowa, Fish at Stanford, Grant at Montana and later at Stanford, Kimball at Cornell, Ennis at Stevens, and others, have done much to develop this phase of engineering education. The introduction of courses in the economics of engineering, has been slow, however; much slower than might have been expected in view of the position that engineers are rapidly taking in relation to

economic problems. I venture to say that if there were more texts available, in addition to those of Fish, Grant, Kimball, and others, this division of our work would grow much more rapidly.

Methods of Teaching

I have tried to determine whether any material change has taken place in our methods of teaching during the past forty years. What little I have learned leads me to believe that there has been virtually no fundamental change. Some little has perhaps been sacrificed in the rigor of our work. There are fewer old-fashioned recitations, with the instructor acting as a quiz master. Less reliance is placed on the examination. There is more give and take discussion in the classroom. Our curriculum, while more liberal and less strictly technological than in 1893, is still very closely prescribed. We still teach our students largely through the medium of small unit assignments and we place great reliance on the textbook. If I am correct in my belief, we do more of the student's studying for him. Instead of throwing the responsibility on him to a greater extent than in former years, I suspect that the tendency has been to take it away.

This paper is not the place to preach a sermon on methods of teaching, but I cannot resist the temptation to say that I believe the weakest spot in our entire scheme of instruction is in lecturing in the classroom on material assigned to the student in a textbook and of repeating in different words the same things the author has said—in a word, studying the student's lesson for him.

If one were to consider individual courses, he could find many illustrations of great improvement in methods of teaching in the past forty years. An illustration is the development of new methods in shop courses. The best example of this that I know is at the University of Michigan, where, under O. W. Boston, there has been worked out a very successful plan of genuine engineering shop laboratory instruction, close correlation with instruction in theoretical courses, and an almost complete change from the older manual training idea of shop work.

Any discussion of teaching methods would be incomplete without mention of the impress made upon them by great teachers and administrators. Mansfield Merriman, Irving P. Church, George F. Swain, C. M. Woodward, Ira O. Baker, J. B. Johnson, Gaetano Lanza, William H. Burr, E. A. Fuertes, William G. Raymond, L. M. Hoskins, and others have all had their disciples, who have consciously or unconsciously modelled their teaching methods on those by which they themselves were taught. Thus, in the field of mechanics, structures, and civil engineering, the men whose names

I have just read, and particularly Church, Merriman, Lanza and Burr, have extended their influence on teaching methods to dozens of schools. Similarly in mechanical engineering, Thurston, Kimball, Green, Carpenter, Breckenridge, Goss, Durant and De Volson Wood; in electrical engineering, Kennelly, Bush, D. C. Jackson, Ryan, Scott, and Pupin, as well as Steinmetz and Lamme; in chemistry and chemical engineering, Noyes, Walker, White, and Lewis; in mining engineering, Eggleston, Drinker, Monroe, Peele, Van Hise and Smythe have had similar influences. It would be quite impossible to overestimate the influence that these men have exercised on engineering instruction during the past forty years. It is safe to say that it will continue to be felt for many years to come.

The Influence of the S. P. E. E.

We come now finally to the one outstanding factor in the promotion of engineering education that is of interest to us all, namely, the influence of this Society.

In no other field of higher education are its members so closely knit in aims, purposes and unity of feeling as they are in engineering education. This, to me, is the outstanding influence that this Society has exerted. Throughout its history it has been a builder of solidarity and of *esprit de corps*. I believe that it is the greatest of all factors that have influenced engineering education, excepting only scientific and technological developments and economic and social changes.

The recent chapters in our history are too well known to need much comment. Beginning with the Mann investigation and report, steps leading to which were begun just about twenty years ago, the engineering schools of the country have been engaged actively in a continued process of self-scrutiny and study under the leadership of this Society. The facts relating to engineering education have been set forth exhaustively. The opinions of the best minds in our field have been brought to bear upon our problems. In no other division of higher education has more effort been expended to bring scholastic work into line with the changing needs of students and of society and industry. We are fortunate indeed to have had available during this work a man of the intellectual stature of Dr. Wickenden.

Nor, may I say, has more been done in a concrete way for the elevation of standards or the improvement of methods of instruction. The Summer School for Engineering Teachers, now in its seventh year and twelfth session, has had a far reaching effect in improving engineering instruction. To date over one thousand teachers have come within its influence and its benefits have extended indirectly to a far greater number.

In fostering these and other efforts, the Society has set a very high standard of concerted group action: the investigation of 1924 to 1929, based upon the principle of investigation by those directly concerned, and the Summer Schools have set important precedents in higher education. The investigation enlisted the support of cooperating committees in over one hundred institutions. The publication of results in a series of bulletins extending over the entire period of the investigation has been the means of bringing into adoption suggestions and recommendations which in earlier efforts had to overcome long-standing inertia.

If our Society can maintain the standard of performance which has thus been set, if it can continue the record of the past forty years, and, in particular, if it can develop, broaden, and enrich engineering education as it has during the past twenty years, which, it is significant to note, is coincident with the secretaryship of F. L. Bishop, we need have no fear for the promotion of engineering education for the next forty years to come.

CONFERENCE OF ADMINISTRATIVE OFFICERS

A RÉSUMÉ OF THE MADISON SESSION*

By GEORGE A. STETSON, Editor, A. S. M. E.; Member, Council S. P. E. E.

Following five busy days at the Forty-first Annual Meeting of the Society for the Promotion of Engineering Education at Chicago, Ill., during Engineering Week, a group of 6 presidents, 52 deans, and 30 heads of departments of engineering colleges, and 7 others representing foundations and societies met, at Madison, Wis., July 3 to 7, 1933, in a Conference conducted by the Society's Board of Investigation and Coördination with the coöperation of the University of Wisconsin, the support of the Engineering Foundation, and the Carnegie Corporation of New York. The total registration of 95 was drawn from 64 colleges and universities and 33 states. The participants in the Conference, with their wives and the members of their families accompanying them, were comfortably housed in the University's dormitory, Tripp Hall, on the shore of Lake Mendota. Meals were served in the adjacent refectory and the sessions were held in a large lecture room in the Soils Building within a short walking distance. Local arrangements at the University of Wisconsin were under the supervision of Dean Frederick E. Turneaure, and Ben G. Elliott, professor of mechanical engineering. Courteous attention was given by the local committee to the comfort and pleasure of the members of the conference in providing recreational facilities, sight-seeing trips and inspection of University buildings, laboratories and grounds, and a boat-ride and picnic on the evening of July 4.

The object of calling the Conference of Administrative Officers of Engineering Colleges was to consider administrative problems and policies, notably those arising out of present economic, industrial, and educational conditions. At the opening session, Prof. Charles F. Scott, Chairman of the Board of Investigation and Coördination and of the special committee charged with its organization and conduct of the conference, whose other members were Frederic L. Bishop, secretary, and Harry P. Hammond, Director of S. P. E. E. Summer Schools, pointed out that the value of the conference lay in the free discussion, formal and informal, of the problems and policies confronting administrative officers, and that the interest, in-

* This Summary of the Conference of Administrative Officers conducted by the Board of Investigation and Coördination, S. P. E. E., Madison, Wisconsin, July 3–7, 1933, was prepared at the request of the Board.

formation, and inspiration so generated might serve as a basis for the decisions of individual institutions on important matters of policy. It was his hope that constructive long-range planning would not be forced to the background by the emergency problems of present transient disturbances.

The Present Status

The conference opened with a symposium, led by Harry S. Rogers, Dean of Engineering, Oregon State Agricultural College, on the general status of engineering education today in the several sections of the United States. This symposium is summarized by Dean Rogers * in an article appearing elsewhere in this issue of the JOURNAL.

The Future Outlook

After the several reports on present status at the morning session, Dr. Charles R. Mann's inspiring outlook for the future, with its challenge to engineering education, set a more hopeful tone. Speaking on the financial outlook for higher education in the next decade, Dr. Mann stated that it would depend on how well the people recognized that they got help from educational institutions. The cost of education, viewed as a national expense, was small, being one half of one per cent of the national income in 1929, and at present not more than one per cent of it. There were, however, evidences of resentment against higher education. Cuts in salaries, amounting to 75 per cent in one state, had resulted from official policies of limitations on such expenditures. In some localities, bankers had refused loans unless salaries in educational institutions were cut and certain educational "frills"—music, art, manual training—were abandoned. Such resentment, he said, was bound to retard growth even after the depression ceased. Failure of college graduates to find and hold jobs during the depression had tended to discredit college education.

With the activities of citizens' councils looking into community expenditures with the idea of proper allocation of funds, Dr. Mann continued, the grants to educational institutions would depend on their rating relative to other publicly supported projects. Here the Wisconsin idea of coöperating with the state, which had been so successful in raising educational income in 1900, might be resorted to to-day. Dr. Mann then suggested that the radical changes in the basic relationships between government and business, embodied in the National Industrial Recovery Act, provided a field in which educational institutions could exert a constructive influence.

* Since the conference was held, Dean Rogers has accepted the presidency of the Polytechnic Institute of Brooklyn.

"If the schools train people to take part intelligently in experiments with centralized control and decentralized responsibility," he said, "they will make such a contribution to American life in the next ten years that there will be no question as to their financial support. The opportunity for service was never greater than it is to-day. A new social and economic era is dawning. The financial outlook for those institutions that best help people learn to play the new game was never as bright as it is to-day. If schools meet the present challenge effectively, the people will be spending a great deal more than one half of one per cent of this national income on institutions of higher education ten years from now."

Budgetting and Finance

The problem of budgetting and finance was presented by O. M. Leland, Dean of Engineering, University of Minnesota. After an analysis of sources of income, methods of increasing income, emergency financing, and the preparation and organization of the budget, Dean Leland came to the subject of retrenchment and the steps to be taken in reducing the budget. He listed the order in which retrenchments by departments should be undertaken and offered the following principles and suggestions in retrenchment.

1. Essential activities, units, and organizations must be preserved for continuous operation and the future of the college. Permanent crippling must be avoided.

2. Partial suspension or reduction may be necessary and possible without permanent loss.

3. Plan for gradual recovery.

4. Retain the basic set-up for research and service as well as the indispensable instruction, although funds may have to be seriously curtailed.

5. Economies may be effected in many small items which will aggregate considerable sums.

6. Educational adjustments may be desirable; such as, reduction of enrollment by a higher selective process, increased size of classes, greater teaching loads, temporarily, and omission of less essential elective courses, restricting choice by students.

7. Administrative adjustments, such as, combination of colleges or departments, abandonment of departments which are no longer necessary or have outlived their usefulness, grouping of services in centralized units, and the use of part-time employees or division of employees between departments.

Selection and Development of Faculties

J. W. Barker, Dean of Engineering, Columbia University, speaking on the selection and development of faculties, listed the

qualities desirable in permanent staff members and capacities which should be looked for in juniors. His list was headed by scholarship, which, he said, should be broad and of a high degree, capable of continued development. Character came next, with the dictum that teachers must be exemplars on and off the campus. The power of exposition was his third requisite; vision and foresight his fourth; a gift of humor, fifth; and the desire to work with budding minds, sixth.

Good teachers, he said, were the product of much labor by their seniors. There should be plenty of cross-fertilization and avoidance of inbreeding. He approved of the practice of assisting young teachers by visiting their classes and by advice on methods of teaching. He advocated the group conference for those teaching related subjects.

On the question of the length of time a young teacher should remain on the staff immediately after graduation, Dean Barker set two to three years, to be followed by practical experience for three or five years, or teaching experience elsewhere, supplemented by practical work during the summer, or by summer sessions in other institutions augmented by periods spent in industry and practice.

In Dean Barker's opinion, junior staff members should be represented on faculty committees. It was sometimes worth while to thrash out administrative problems in the presence of junior staff members, he said, and thus to introduce them to the cross-relationships of departments and schools. He was particularly impressed with the desirability of a healthy development of the social aspects of faculty relationship, and of faculty-student life.

In discussing the relationship of faculties and administrative officers, Dexter S. Kimball, Dean of Engineering, Cornell University, said that the new idea of a university involved a great amount of administration. It was his opinion that faculties should have more to say about the aims and policies of an educational institution. While he admitted that boards of trustees were desirable and necessary under the present set-up, it was difficult, he believed, for such groups to appraise factors that arose in administration, and hence they should consult faculties more freely and more frequently. It would be desirable, he felt, to have the faculty represented on the board of trustees.

Dean Kimball spoke feelingly of the onerous administrative duties of a college president. It was too seldom, he said, that presidents got faculty advice, yet it was possible for them to do so through some such device as a weekly conference of deans, which could develop into a valuable clearing house of administrative difficulties. He also spoke of the Committee on University Policy which dealt with such problems as the recruitment of the faculty,

the maintenance of the faculty at a high standard of excellence, tenure of office, and student relations.

Personnel Problems

At the session on personnel matters, Edward C. Elliott, President, Purdue University, spoke on the problem of aiding students affected by the depression. It was the duty of the educational institution, he said, to make the student aware that the country was passing from one epoch into another. In such a circumstance, it was imperative to develop the morale of the student body. A sense of self-responsibility should be fostered in the student to increase his independence of the university.

Speaking of specific ways of helping students, President Elliott put first in his list a spirit of honesty in questions involving the student. He should be advised not to enter college unless he had sufficient funds to carry on his studies without serious handicaps. Care should be taken not to add to the human scrap heap outside the doors of educational institutions, and not to lead the student into some blind alley. Practical methods of help lay in the reduction of fees and cost of textbooks and in the expenses incurred in extra curriculum activities. "Busy work" for graduates out of jobs could be of help to them. President Elliott concluded his address by saying that engineering colleges must make sure of their process of recruitment so that engineering might go on in the next generation.

Paul Cloke, Dean, University of Maine, speaking on the recent engineering graduate, pointed out that whereas depressions did not last forever, they did have far-reaching effects on engineering education and graduates. He recalled data compiled by M. M. Boring, of the General Electric Company, to show that the percentage of recent graduates in medicine that had been placed in jobs was greater than that in the other professions. He felt that emphasis on quality of their products had reacted favorably to the medical schools in this respect. He protested at calling graduates in engineering "placed" when they had taken non-engineering jobs or continued their studies in graduate courses. In his opinion, the law of supply and demand would operate to reduce the number of men entering engineering schools. In the case of recent graduates, older men, who had been discharged, would be replaced by younger men. He protested the practice of industrial concerns in placing some of their able men temporarily on teaching staffs in dull times, and in drawing good men away in boom times.

J. W. Barker, of Columbia University, spoke of the work carried on in New York in connection with the Professional Engineers

Committee on Unemployment which had provided educational facilities for unemployed engineers during the past year. He gave in some detail the experiences of Columbia University with its plan of permitting such men to register in certain classes upon presentation of a certificate from the P. E. C. U. Admission was without credit or fees up to the limit of classroom seats. Laboratory courses were not included. He also described the lectures held under the auspices of Engineering Foundation, in the Engineering Societies building, to which instruction was contributed by the educational institutions of the Metropolitan area.

In discussing the function of the administrative officer with reference to graduate work, Professor Dugald C. Jackson, of the Massachusetts Institute of Technology, said that teachers that direct such work must have sufficient respite from the execution of conventional details so that they might give productive contemplation to each individual student's qualities and ambitions, as well as to the advancement of knowledge in the field.

"The administrative duties which have reference to graduate work," he said, "are, first to understand the needs of the work, then secure and maintain an appropriate staff, and finally to provide the staff with facilities and encouragement. The conventional heavy allotment of specifically assigned teaching hours is a preventive of the best originality and resourcefulness in undergraduate instruction. It is wholly out of keeping with making an inspiring success in graduate instruction. The administrative problems of staff related to the topic simmer down to securing men of suitable intellectual qualities, encouraging their ambitions, and limiting their assigned specific teaching hours. In my opinion no engineering school is justified in advertising that it undertakes graduate instruction unless it has one or more men in staff who have a real mastery of some division of engineering and who can be protected from an excessive number of assigned conventional hours in classroom and laboratories. It is also desirable that the institution should possess departments of science, especially mathematics, physics and chemistry, which are equally alive."

The subject of junior colleges and their relation to engineering schools, curricula, and admission qualifications was discussed in a paper by George F. Zook, United States Commissioner of Education.

President Wickenden's Address

On Thursday evening, members of the Conference were privileged to hear President Wickenden's inspiring address on engineering education in the light of changed social and industrial conditions. President Wickenden began his address by reminding

his audience that the present conference represented a culmination of a train of activities covering a decade of effort to develop, broaden, and enrich engineering education. He pointed out that, in America, the establishment of the colonial system, the raising of it to political and economic self-sufficiency, the completion of the expansion of the national domain, and the establishment of an industrial order of society, had each covered periods of about eighty years. Signs that we had now reached another turning point were appearing on every hand. The last two of the epochs already completed had been highly significant for the technical professions, and if a new deal was impending, he said, the engineer was likely to find his work and prospects directly affected.

Passing hurriedly in review over these two important epochs, President Wickenden summarized the altered conditions which foreshadowed a new epoch as (1) adequate capacity to produce, with the use of barely one-third of the population to supply material necessities; (2) the stabilization of population with an altered scale of resource valuations and a lowered pace of industrial expansion; (3) the reversal of our international economic position from debtor and exporter, to creditor and, in prospect, importer; and (4) the growing ascendency of corporate over individual interests and of functional over political interests.

He then cited a number of social adjustments to these altered bases of national economy that were now taking form. First, there was the new balance to be struck between agriculture and industry, in which the engineer and chemist might be called upon to broaden the industrial outlet for agricultural products and to by-process waste materials. Second, a new balance was being struck between consuming and producing power which would inevitably carry with it a new valuation of goods, economic security, leisure, recreation, and cultural opportunity as the rewards of human effort, and because of which the scientific worker of the future would have to look more largely to the consumer for employment. Third, the new balance between internal and international economy might result in a substitution of technical superiority for a tariff wall as a source of protection. Fourth, public enterprise and private industry would be found in a new balance, with the result that a new type of government, based on industrial and occupational interests, might grow up alongside of our present government which was based on geographical and political interests. Fifth, a new balance between realistic and idealistic forms of education was to be struck as a result of an increase in the relatively greater numbers of adults of later maturity in our population. Sixth, there would be a new balance between utility and economy on the one hand and convenience and beauty on the other. Seventh, there

was hope for a changing attitude in the realm of industrial ethics toward the making of wealth, which might insist that the process of making money, as well as its disposition, should directly serve social ends.

President Wickenden next asked the question, What has the engineer to gain or lose in such changes of balance, and what distinctive contribution can he make to a new age? The historic rôle of the engineer, he said, had been to take the guesswork out of construction and production by a blend of horse sense and science, and to put self-interest in the background under a code of professional ethics and responsibility. The place which he would be able to claim in a changing society would depend on his ability to change with it, to bring new scientific resources to bear, and to broaden the area to which he applied his characteristic procedures.

The engineer of tomorrow, said President Wickenden, could not afford to slight the study of history, economics, sociology, and political science. This did not imply, however, that the engineer would become a propagandist or a revolutionary. He would not necessarily displace bankers, lawyers, economists, journalists, social workers, and politicians in the direction of our common concerns. His field of natural leadership was that of factual, analytical, constructive planning and action on material problems.

In coming to a consideration of educational functions and processes, President Wickenden said that engineers would continue to deal primarily with things and forces and incidentally with persons and social relations. Until a better equilibrium could be reached between technical and social control, the safety of society demanded a type of leadership in industry highly sensitized on the side of social ethics. It was the business of the engineering profession to provide this leadership. In his opinion, the engineer of the present lacked a sufficiently humane understanding of the results of his work on men as persons.

The core of the educational program, he said, was the recruitment and training of an inner nucleus of professional engineers. The problem was now qualitative, rather than quantitative. We had no concern with the young men who lacked ability, or interest, or the preparation to *master* a group of sciences basic to engineering. Our concern as educators, he said, was to develop men who would be able to deal in a more statesmanlike manner with the major economic and social problems within their normal areas of responsibility, and it was encouraging to note that the newly formed Engineers' Council for Professional Development contemplated a scheme of educational guidance reaching down into the secondary school, bridging the college period, covering the early years of professional activity, and envisaging some comprehensive appraisal of

educational attainment at a mature level as a qualifying standard for certification with the profession.

In closing he said, "Society will choose it leaders from every calling, and we may confidently hope that the engineering group will supply an even more generous share than in the past, but if we turn aside from the training of men who are specially qualified to direct the great sources of power and the treasures of nature's storehouse to the service of men, with an enlightened scale of social values and under an austere code of professional integrity and duty, we do so at the peril of our civilization."

External Relationships

H. H. Horner, Assistant Commissioner of Higher Education, The University of the State of New York, in discussing the relationship of the state and engineering education, spoke specifically with reference to the State of New York. That state, he said, justified the issuance of licenses to practice in the professions, including engineering, primarily on the basis of the safeguarding of life, health, and property. He described the conditions existing in the licensing procedure affecting architecture and engineering which place the two professions on a substantially equivalent educational basis, and cited the qualifications with respect to education and training that must be met by candidates for license after January 1, 1937.

Looking forward to the enforcement of these conditions in the licensure of engineers, he said, the State Education Department was reconsidering its list of registered schools and was calling into frequent conference the deans of schools and colleges in the state to consider degrees conferred in engineering, courses of study, and the scope and content of state licensing examinations.

In regard to degrees, a great variety of practice was found, but a proposed uniform scheme had been worked out. In respect to courses of study, it was the view of the deans of schools of engineering in the State of New York that the Education Department should not set up elaborate specifications for determining the standing of an engineering school, and that no exact number of semester hours should be specified for the bachelor's degree; however, it was suggested that a satisfactory course should ordinarily cover from 140 to 150 semester hours. It was the unqualified judgment of the deans, he said, that a clear distinction should be kept at all times between degrees and courses of study in schools of engineering and state licensing examinations, and that the State Education Department should not permit the examination to impose restrictions upon teaching and research.

In approaching the problem of accrediting engineering colleges, Prof. H. P. Hammond, Polytechnic Institute of Brooklyn, pointed out that it must be recognized and dealt with as a fact. The present question was not to determine whether there should be accrediting but who should do it; the schools individually or through the S. P. E. E., or through the Society's membership in some other representative agency.

The types of organizations concerned with accrediting, he said, were regional educational associations, national educational associations, associations of professional schools, professional associations, national engineering societies, and governmental agencies. The factors to be considered in the accrediting of an institution were its organization and support, its curriculum, its admission methods and requirements, its physical plant, library, and teaching staff, its finances, and its general standards of quality of work, with more emphasis upon quality of work than had been the case heretofore. While procedures in connection with the machinery of accrediting differed widely, most of them involved the collection of information from publications and by means of questionnaires.

Summarizing the present status, Professor Hammond said that engineering colleges were now accredited as institutions of higher learning by several regional and national associations that had to do with accrediting; they were recognized as "approved" institutions for purposes of evaluating membership qualifications by the National engineering societies, and, in a very real way, they are recognized by state licensing boards.

It was fortunate, Professor Hammond pointed out, that at the present time when state licensing boards had begun a systematic process of accrediting, there should have come into existence the joint agency of the engineering societies, the state boards of engineering examiners, and the S. P. E. E. known as the Engineers' Council for Professional Development. This Council had appointed a committee on engineering colleges "to formulate criteria for colleges of engineering which will insure to their graduates a sound educational background for practicing the engineering profession." Such benefits as uniformity of procedure, equality of representation, action resulting from informed opinion, and the avoidance of duplication were expected to come from the accrediting of colleges by this agency. No attempt was to be made to classify schools in groups according to rank or excellence, and the committee, Professor Hammond concluded, was not to limit its function solely to accrediting; it hoped to assist colleges constructively and to form one more tie between the schools and the professions they serve.

Summary and Comment

The foregoing has been a résumé of the high spots of the formal addresses at the Madison Conference. Necessarily sketchy, it has done scant justice to the zeal and wisdom of those who addressed the Conference, and many serious omissions will be noted, principally that no picture of the spirit of the gathering has been attempted and no mention has been made of the numerous able discussions that followed the addresses. In what follows, the reviewer, who attended the Conference as an interested observer, is expressing his own impressions and his own opinions.

At one of the very delicious meals during the Conference, a dessert was served the principal ingredient of which was the whites of eggs. Comment on the prodigality of using only part of a normal egg turned to the question as to whether an equal number of yolks might subsequently appear as part of another meal or whether, perhaps, Madison hens laid eggs without yolks. Should the latter alternative prove to be the case, it boded ill for a conference that might produce a splendid but inconsequential froth and neglect to provide a very substantial and golden yolk. Observation failed to discover any dish in which egg yolks might have played an important rôle. It is to be hoped that the meat of the Conference is now undergoing digestion and assimilation in the minds of those who attended it.

The discussion of administrative details is undoubtedly useful and necessary, but the mechanisms by which educational processes are conducted are of small value as compared with objectives and the success with which they may be attained. One would suppose, for example, that a group of men heading the leading engineering colleges of the country, meeting at a time when strong and fresh currents are stirring in national economic life, would be so filled with their significance and implications that they could talk of little but the manner in which the ideals and objectives of education were to be affected and the opportunities and responsibilities that were being unfolded for the teachers of young men preparing to enter industry and engineering. Yet the impression carried away by the present reviewer was that more concern was felt for temporary, although very real, limitations in the way of reduced budgets than for the broader opportunities presented in the program of socialization and planned economy sponsored by the present administration. To be sure, these aspects were discussed by Dr. Mann in a very practical manner when he suggested that an effort on the part of educational institutions to furnish guidance and understanding in the perplexing situation developing from day to day and based on the "partnership" of business and government would

result in greater income, and in a very inspiring manner by President Wickenden in his address, and conspicuously by President Elliott and Dean Rogers in informal talks, but those thoughts did not seem to strike the fire of zealous purpose that would have kindled the Conference into a livelier heat from which the refined metal of future plans might have been cast. Fortunately, it is not too late for this to happen, and undoubtedly at this very moment such plans are being formed in many engineering schools throughout the country.

That critical analysis had begun was evident from the discussions of reduced budgets and enrollments, which naturally disturb complacency, interrupt routine, threaten security and stability, and suggest reforms. The financial conditions of the engineering schools present grave problems. Expansion of physical equipment and educational and research programs are held up; salaries, notoriously inadequate, are further reduced; reductions in staff become necessary; consolidations and eliminations of schools and courses demand changes in curricula and increases in teaching load. But these are temporary problems. Of more serious consequence are such problems, for example, as the inadequacy of preparation of students because of the shortening of secondary-school curricula; the loss of new blood from the failure to appoint young instructors to the teaching staff; the teacher who has stopped growing, but who is weathering the economic storm in the harbor of the classroom; the groups of disappointed and disillusioned graduates facing the bitter experiences of unemployment; the critical and resentful taxpayer and legislature who have withdrawn support, both moral and financial.

Yet these problems are not without their compensations. Absurd duplications of schools, courses, and effort can well be eliminated; opportunity is given for the pruning of educational "frills" and fads; paternalistic concern for under-graduates takes on a saner aspect with potential gains in self-reliance to the individual; truer values are attached to college education; graduate study is encouraged; dead wood can be hewn away without loud protest; emphasis can be placed on essentials.

In fact, the processes at work in our national life are also at work in educational institutions, as President Wickenden pointed out. To use his suggestive figure, new balances are being struck between agriculture and industry, between consuming and producing power, between internal and international economies, between public enterprise and private industry, between realistic and idealistic education, between utility and economy on one hand and convenience and beauty on the other. In all of these, new balances, the engineer is concerned; and the youth of today is going forth

into a world in which the new balances, rather than the old, are likely to exist. To be made conscious of them and to prepare himself to live purposefully in happiness and security is a prime function of engineering colleges. And to this function deans and faculties must respond or serve youth badly.

Presumably engineering schools are training men for the engineering profession, the profession itself is feeling the impact of social, political, and economic change. Its consciousness of this fact is betrayed by such a simple example as the change that has taken place with regard to the question of licensing and registration of engineers. This, with many others, including the educational process, is bound up in the recently established program of the Engineer's Council for Professional Development, of which the S. P. E. E. is one of the seven joint sponsors. The high hopes expressed at Madison of the services that this Council may render engineering education and the engineering profession will not be realized if engineering educators fail to do their part or do it badly. Fortunately, tradition gives encouragement to the belief that educators will neither fail nor perform badly, for a society which has to its credit the exhaustive study that the S. P. E. E. undertook during the years following the world war and the summer schools for its teachers can hardly be expected to rest on its laurels and lose its pioneering spirit.

The engineering profession needs men as it never needed them before, and only the best will do. Because one in seven Americans attends a college does not argue that one in seven is competent to become an engineer. Relatively few are. The educational process is difficult and costly. From it should be excluded the unfit and the unworthy. Upon the engineering school the responsibility of selection and training lies.

One further comment remains. Dr. Mann showed how the spirit of the day in the relationship of industry and government was one of centralized control and decentralized responsibility. The principal is worthy of study and extension into engineering education. It provides the means by which our cherished individualism may be reconciled to the broad socializing movements that are reshaping our national life. No group of men are by nature better able to comprehend the validity of this principal or to use it more intelligently than are engineers. By its application they have made conspicuous contributions to the management of industrial enterprises. To train the youth to think in terms of this principal, and to educate him in a manner which takes practical account of it, is to perform a valuable service for him, and for his fellowmen.

PURPOSE AND SCOPE OF MINING AND METALLURGICAL ENGINEERING EDUCATION *

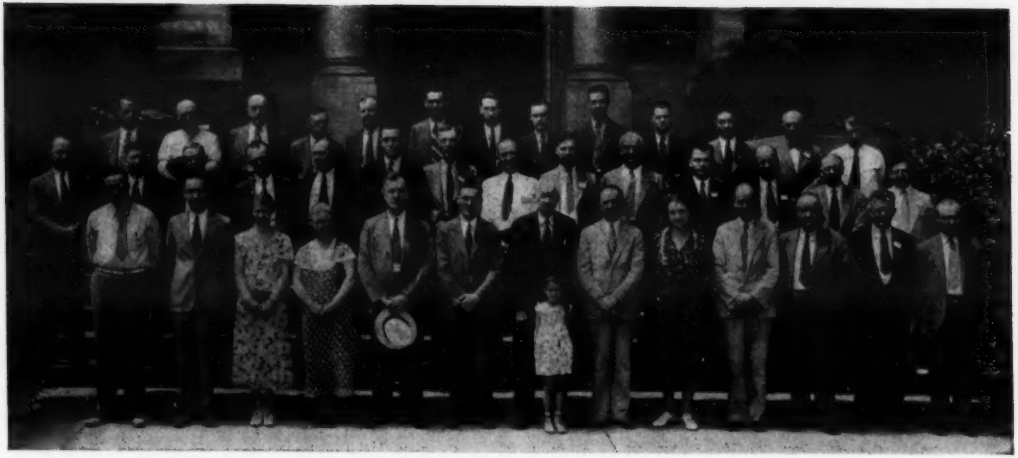
By E. A. HOLBROOK

Dean, School of Engineering and the School of Mines, University of Pittsburgh

The arts of mining and metallurgy are undoubtedly more ancient than civilization itself. Certainly every upward step in civilization has had behind it the worker in metals and the miner to produce these earth found metals. Historians tell us that the victorious nations who forced their civilization on the vanquished were those possessing superior arms and armament. Thus the flint-possessing man conquered the club-possessing man, and the copper-possessing man in turn conquered him. Eventually evolved the civilization possessing iron weapons and armour, which gave way rather recently in history to the steel-possessing civilization. Behind the Damascus sword were unknown metallurgists and miners; behind the British battle ships at Jutland were the nickel mines of Canada; and behind our aircraft and armament of the present and future are ever the research and operating metallurgist, the petroleum engineer and the miner. In so far as we can judge the future by the past, both the science of war and the science of peace will depend on the products of the earth and their utilization. Technique and emphasis may change, but so long as we continue as civilized human beings I see no escape from the services of the mineral producer and the mineral fabricator. Those who are pessimistic about the future of our mineral technology professions, therefore, are limited in their vision. It is *not* important that enrolment at a mining school increase or decrease this year or next; it *is* important that our generation have a knowledge and a faith in the essential worth-whileness of our contribution to the world, and that we hold aloft this torch and pass it on with increments of fuel for the light of the next generation. Let us take as our tenet of belief—*We are essential to our community, to our country, and to the world.*

I recently read a book called "The Engineering Professions" edited by the American Association of Engineers. When I had finished it I jotted down this note: "By this book I have come to a better understanding of the place and importance of my profession

* An address delivered at the Mining and Metallurgical Session of the Summer School for Engineering Teachers, University of Wisconsin, July 5, 1933.



MINING AND METALLURGICAL SESSION OF THE SUMMER SCHOOL FOR ENGINEERING TEACHERS
University of Wisconsin, July 5–25, 1933.

in this civilized world." It is not so important that the book contained engineering information; it is important that after thirty-three years of varied professional work I could find myself refreshed, strengthened, and renewed with a new point of view and a new belief in the worth-whileness of what I am doing. You and I concern ourselves too much with the humdrum and routine of teaching; with acquiring and imparting the exact information that the drill holes should be six feet, six inches deep; that the crusher in the mill is style D; that the furnace capacity is A tons; or that the limestone is overlaid with a sandy shale. All of these facts may be useful information for the moment and impress our class, but I fear that too much exact and scientific knowledge is causing us to shrivel up. I am sure that because I have believed fully in the importance of these details, I have at times not been able to see the forest for the trees. Today, then, I plead that we shall take account of stock in our teaching; look again at our raw materials and at the machines that fabricate them into graduates; at the tools that we are using and at the product we think we are producing, qualitatively and quantitatively.

The Study of Engineering Education by the Society for the Promotion of Engineering Education has told us that we were doing a pretty good job; and so we are, as measured by statistics and charts and credits and subjects and all the rest of the scientific data collected. However, the most elusive and yet the most real thing about our work is as yet missing from these reports. This missing factor is centered about the intangible human values called morale and spirit, which show themselves in a thousand ways in teachers, in student attitude, in subject matter, in graduate interest, and in professional success. Why can't we admit that the attitude of a recent graduate towards his profession is of more importance than his knowledge of the details of his profession? Some day, engineering and mining schools will be judged, not on the wealth of details in their several curricula, but by the point of view they plant in the departing senior. In our kind of education we deal with three factors: content, method, and attitude or spirit. Of these, the least important is content and the most important is the spirit or attitude imparted.

We have seen that mining and metallurgy were arts passed from father to son for generations before the first mining school, the *Bergacademie,* was founded at Freiburg in 1765. No one can be long with a "Cousin Jack" metal miner or an English coal miner without knowing that mining is their natural occupation, bred in the bone through successive generations. I think you will find that the greater part of the enrolment at German, French, and English mining schools has come from the families of owners and officials

of mines, boys who came with a mining background and whose principal outlook on life is to live by the same profession and in turn pass it on to the next generation. Every one of us knows what a joy it is to have in our classes a bright boy from a mining family, one who does not have to be sold on the profession. However, after having had experience with five mining schools I am bound to say that in this country we have no such background. In every school the boys from the mining families are a decided minority. In fact only too often the sons of the mining families are becoming aviators or lawyers or general college course men, something that will take them away from the mining background. This means that a majority of our classes are boys attracted to mining because of its supposed romance, its out-door life, a chance to make a good living, or because of the very broadness of the course itself. I find also that the average boy has entered college directly from high school and that boys who have had several years of practical work in their chosen industry are in the minority. This background does not hold quite so rigidly for metallurgy, perhaps, because a modern metallurgical background is so new; but even here, I find the sons of tailors, and railroad workers, rather than the sons of steel men. In petroleum engineering the background is so recent that no parallel can be drawn. Frankly, I have had more mature men with an oil background and more sons of oil men wanting to follow the oil and gas business through proper college preparation than in any other branch of the mineral industries.

I venture the statement that the average boy we receive as a freshman is a recent high school graduate; that he selects a course in the mineral industries because of some trivial reason; that he has little or no background of the mineral industries; and that he believes four years in college will make him a full-fledged engineer. You know and I know that four years in college, especially if there is little chance to work around the mines or metallurgical plants offers the student only the bare rudiments of his profession. The report of the S. P. E. E. showed, for example, that only 50 per cent of the mining graduates followed mining. Personlly, I have graduated a lot of promising young men, only to meet them a few years later as bank clerks, grocery salesmen or in some business with their fathers. Is this the objective of mineral technology education? Years ago a successful mining man told me "Out of five young graduates we get here, only one or two will stick. The rest were not cut out for the work, they are lonesome away from the cities, they want to marry and the girl wants her home life, most of all they were not brought up to get dirty."

Another told me that laboratory work in college spoiled the boy

for actual operating work. Several years ago I talked with an American executive who was on his way to Germany to hire young German engineers for petroleum work in a foreign country. I asked him why he did not hire young American engineers, and he told me that the average young American engineer would not stick in a foreign country, whereas the European engineer was willing to go there, marry and settle down, and make it his life work.

What we ought to realize and admit is that in four years in college the best we can do is to give a boy an engineering point of view, and a *particular interest* in the field of the mineral industries. Our objective ought to be in accord with this point of view, which after all is a way of seeing things, a method of attack, and a satisfaction in accomplishment. These things are as vital in running a restaurant or in leading a polar expedition as they are in sinking a shaft. This modern world, to my notion, needs an increased percentage of men with the engineering point of view in every walk of life. If, therefore, we can somehow give the boy this point of view, I care not if he uses the training in a position in an ore treatment plant or in a dry goods store.

Personally, I don't care if my boy takes metallurgical engineering or if he takes civil engineering. More than half the subjects will be the same in either case. What I do want him to get in college is the engineering point of view. That is, I think we develop something in a boy from study and from the application of mathematics and the sciences, coupled with the definiteness of their application and a habit of study and work. If a college education is to fit a boy into the life he will have to live, then I prefer my boy to have an engineering background rather than any other.

Let me repeat that the first objective of any mineral technology college course is to give that boy an engineering point of view.

The second objective is equally simple; it is to give a boy an interest and a satisfaction in, and a desire to follow and to learn more about, his particular field of work. Some educators recently have argued that engineering and mining schools were going in for too much specialization and that the proper undergraduate background could be had in perhaps one or two departments, leaving all specialization to the years after graduation. I think the proponents of this plan forget two important essentials—first, that it is necessary to give the boy an ideal and an objective, and second that there has been a tremendous development of knowledge in engineering during the past thirty years.

First, I believe it is necessary to attract the boy by what he thinks he wants, and to hold him through the drudgery of uninteresting subjects by the very power of the studies in his self-selected field. The principles of design of a head frame are not essentially

different from the principles of design of a skyscraper, but who could hold a mining-minded boy by having him design a city building? I care not what the subject is, if I can get the boy interested in it early, then I can lead him where I want him to go. I think we teachers have been making serious mistakes in interesting students in our own particular subjects. Our approach generally is as follows: "This course is Metallurgy 79. You have had the necessary chemistry and mathematics as prerequisites. There is so much to be known about the subject that you boys can get only a smattering of it in one semester; therefore, let us waste no time. The first assignment is Chapter I." Now Chapter I of the book is a dry recital of the physical and chemical properties of the metals that will be considered in the course. Nowhere is there any inkling of what the course is all about. In fact it is half over before the student can understand its reason for existence in his little tool box of required subjects. I flatly propose that no course in any professional department be started until the students are told about the course. Specifically, I would develop the course historically for several class periods. In ore dressing, for example, I would tell of the development of ore dressing as an art in ancient and mediæval mining, of the influence of German practice, of early practices in this country and of its rather recent change to a science; also I would explain how the course ties together mineralogy, mining, drawing, physics and other subjects.

As examples of the present style of textbooks we use, I selected three at random; the first was *Hydraulics*, the second *Ore Dressing*, and the third *Geology*. The first Chapter of the book on *Hydraulics* considers "Fundamental Data." It is as dry as dust. The first chapter of *Ore Dressing* considers the "Physical Properties of Minerals" and the first chapter of *Geology* covers "The Work of the Atmosphere." How, I ask, are you going to awaken a boy's interest in these subjects, especially the average boy who knows nothing about them, if you plunge him immediately into a technical discussion of subject matter. I submit that in starting to teach geology the boy ought to be told what geology is, how and when the subject developed; he should be told about Lyle and Dana and other great scholars who have graced the science, and, finally, of how this science is going to be a part of his professional course. I believe firmly that if I try to force a subject on a boy, he will resent it, but if I can make him like it, then the course becomes a real part of his education. In order, we must implant in our students curiosity, then interest, then satisfaction, then pride in the subject, and then love of it. These follow logically and are of more importance than a host of technical details for which the forgetting curve is almost as steep as the learning curve. If we

keep in mind these points we can defend any subject in the curricula of our mining schools.

My second point in justifying our several undergraduate curricula is the recent great development in engineering knowledge.

In no field of learning has there been as much expansion and creation during the past thirty years as in engineering. Let me take petroleum engineering as an example. I finished a complete course in Mining Engineering and Metallurgy in 1904. In my old note books I find I made drawings of a drilling rig and a chisel bit with two pages of notes indicating that these tools were used in the production of oil and gas. I doubt if much more than this had been published at the time. Shortly afterwards came the utilization of geological knowledge in the oil and gas work, followed by the introduction of trained engineers into the field of drilling and production. The Bureau of Mines turned its trained men on the problems and technical publications appeared. Today there is in existence published technical knowledge in the oil and gas industries to form adequate foundation for not only a single undergraduate curriculum but in fact three, Oil and Gas Geology, Engineering, and Refining. Why should any one cry "too much specialization" because of separate undergraduate curricula in these branches? Today we have dozens of fields in any one of which a man may work and learn for a life time, and so diverse that, for example, a metallurgical engineer and a civil engineer hardly speak the same language.

Actually a boy in his undergraduate course averages about 144 credit-hours. Of these generally less than 40 credit hours are taken in his own special department; the other 104 credits are taken in a wide variety of subjects ranging from English to mathematics and to business law. Since the average liberal arts college graduates a man with 120 credits, our average engineering undergraduates often have within one or two semesters of the total credits required for the liberal arts degree. And a boy taking an undergraduate course in engineering is accused of being narrowly trained and without a liberal education! Let us not forget that the time our undergraduate spends in petroleum engineering is not greatly different from the time a Bachelor of Arts has spent in his own major field. I submit that for the world they will live in during the next fifty years a course in the application of the beautiful principles of mechanics and thermodynamics to the great petroleum industry may breed a satisfaction in living and a sense of being a part of the world equal to a knowledge of the Second Punic War.

Some people are educated to a love of paintings. Personally, I think I get the same satisfaction in standing in a great power

house and admiring the running of a giant turbo-generator. Not that I do not admire a painting, but in that generator, through my training, I can vision the genius and life work of a hundred men who have made the miracle possible. I have an inward satisfaction and a mental stimulus from my contemplation. Tell me, am I less educated than he who loves the painting, or only differently educated? President Elliott of Harvard once said "An educated man is one who has formed the habit of doing with extraordinary excellence anything for the benefit of mankind." I submit to you that an undergraduate education in our branch of engineering is, and ought to be, one path towards the attainment of this ideal. If we keep these points in mind we ought to be able to justify what we are doing in mineral technology education and know why we are doing it.

We have been too prone to treat our undergraduate work as a humdrum matter of courses and credits. We boast that we give ten credits in this subject and that we are, therefore, better than the institution that offers only eight; that a boy is forever damned because he has missed a course in mine management and is, therefore, not worthy of our degree. Above all things he must meet our petty and artificial operating standards. We pride ourselves that our passing mark is 70 per cent and, therefore, we are better than the institution whose passing mark is 60 per cent. I think we have set up false gods of material achievements, largely because the public and the students could understand us in these terms, and we have made these petty standards of professional training our ideal. Our profession itself is not an ideal, it is only a method wherein certain ideals may be expressed. Let us then attach ideals to our profession, but let them emphasize the high ideals that ought to be common to every profession and not the petty things of course content and inconsequential details.

If I could take a high school boy and in four years teach him to write and speak good English, give him a working knowledge of mathematics and some of the basic sciences, some courses in his selected field which he liked with intellectual curiosity, and an equal number in related fields; if I could let him taste a bit in one or two other fields of learning, and perhaps smell at another; if I could form in him good habits of clean and neat dress and a method of attacking problems; then I would feel satisfied with my four short years with him.

At the end of four years we graduate an assorted lot of boys, somewhat less than half of those who entered. We privately decry how little they know of their profession and perhaps tell each other how much better a job we could do if we had them for five or six years. Indeed I have heard engineering educators say that

the time has come when four years in college is no longer enough for their own particular branch of the profession and that their aim and object is to make the undergraduate time five or six years.

I think they miss the aim and object of an undergraduate engineering education. As I see it, a four-year undergraduate engineering education is not a professional education in the same sense that law, medicine and theology are. Undergraduate engineering education is simply one variety of undergraduate college education with some emphasis on certain fundamental professional work.

Some time ago I was talking with one of the leading mining educators of Great Britain. I told him it was my observation that the engineering profession in Great Britain did not command the same professional respect and have the same professional standing as did the professions of law, medicine and theology. He replied that there was a difference, but that I had the wrong point of view. He was glad and proud to say that engineering was different, but it was a difference of kind and not of degree. He held that the theory and practice of the older professions was exact and that they had a purely professional background. He held, however, that the practice of engineering is and always should be for the majority a decided mixture of profession and business; that the older professions were arts, or perhaps, in medicine, to a degree a science, whereas in engineering, we sometimes observed it partly as an art, partly as a science, but in most cases modified by the methods and needs of business. We have, therefore, in an engineer, a different kind of man whose training and whose standards can not be paralleled in the older professions.

I am inclined to agree with this point of view and from it shall defend our present four-year college course.

Checking up on several hundred graduates in mining and allied courses I have known during the past twenty-three years, I am inclined to the belief that four years in college was all they needed and all that was good for them. Their average age at graduation was just under 23 years; most of them had attended school continuously for seventeen years. Their experience in the world of doing in the mineral industry was less than one year, sometimes only a few inspection trips. They had tried their wings mostly in a laboratory. It certainly is time for them to get out on the firing line of industry and business and find out what it is all about.

My estimate is that 70 per cent of these four-year graduates will be happier and more successful in life if they then stop their college training. I find some of them have developed in industry from laborers to foremen to superintendents to general managers and to higher executives. Their college training gave them a background, a method, and a confidence; the rest has been character,

executive ability, willingness to coöperate with men, good health, and the other common attributes. Their names are listed as engineers, and yet we all admit that they are far from following a pure profession. I find others high in sales work, or successfully holding positions not closely allied to their major work in college. I believe this group has constituted, will constitute, and ought to constitute the majority of men we graduate in our mineral industry courses. Mostly, they apply few of the subjects they had in college directly to their work. In my own first seven years out of college I can not remember that I ever applied directly any of the problems I solved in college, with the possible exception of those in surveying. I did have a background which gave me confidence and a quick understanding and a method of attack without which I could not have carried on. Most of our graduates were not and are not scholars by nature or inclination. They are happier in the world of realities and of doing and are interested in book learning only when it applies to their work or as a recreation. I honestly believe that two or three years more in college would have unfitted them for their present work and would not, as a recompense, have produced scholars, research men, or strictly professional engineers.

There are, however, among my list of graduates about 30 per cent of a type who can be defined roughly as fitted by nature for investigative or research work, for teaching, for purely professional work such as designing, or perhaps for technical editorial work or for other work auxiliary to an industry.

Personally, I believe we ought, for the sake of background, to advise all of our graduates to enter industry immediately in some capacity. Sooner or later a considerable part of our 30 per cent will find themselves in need of further study in their particular field. For example, I find that electrical design work has become so advanced and specialized that the ordinary four-year graduate hardly has the background to succeed. For him and those in allied lines we have developed graduate courses of such breadth and extent that even a Ph.D. is possible.

Of the courses ordinarily given in a mining school, it appears that metallurgy offers the clearest case for the need and desirability of graduate work in mining schools. A few years ago many graduates were products of a combined mining and metallurgical course. Metallurgy developed out of mining, perhaps because of the close association of mine and treatment plant. Then came the chemist and the physicist who found in the metals a fertile field for their sciences. Perhaps their most distinctive contribution has been metallography. These forces have caused metallury to leave its old orbit of mining and to progress under the great pull of

chemistry and physics. To-day, in many schools, metallurgy has no connection with mining and indeed is controlled and directed by those with a scientific training not closely related to mining. In any case, the subject has been carried to an advanced position where undergraduate work serves only to give the rudiments of present knowledge. It seems essential if men are to develop in metallurgical research that they have an advanced training in physical chemistry and other sciences and in their application to the field of metallurgy. It is for this kind of man and this type of work that we can justify and foster graduate work.

In the application of geology to oil and gas work or in the application of chemical principles to oil refining I can also see the justification for considerable graduate training. In mining engineering or in petroleum engineering I can see that, after considerable field work and a fond desire to specialize, a man is justified in taking graduate work. However, for service in either the mining engineering or the petroleum engineering fields, I can not see that more than one year of graduate work is ever justified and I think we are wrong when we try to build up this graduate work without limiting carefully the students according to their background, their inclination and their probable future work. In plain words, if I were running a mining company I could use young men with college degrees in mining who were willing to learn more by experience. I would not know what to do with a man three years older with a Ph.D. in mining and of equal inexperience.

I believe, then, that we have in the mineral industry professions today a body of knowledge sufficient to justify graduate work even to the Ph.D. degree, but that more harm than good will come from a blind copying of the liberal arts and science courses by pushing graduate courses as of universal benefit to our young men. Above all, the main aim and object of our schools should not be to build up graduate work, even in order to maintain social cast in the university, but our main job still is with the undergraduate.

I want now to speak of the place of research in our work.

Is research one of the purposes of mining and metallurgical engineering education? You expect me to answer "Yes" and I shall do so, qualifying my affirmative, however, by saying that more foolish things have been done at our technical schools in the name of research than in almost any other way. Several years ago I heard the head of a large college make the statement that no man on his faculty could hope for an increase of rank or salary without completing research and publishing the results. Here teaching and the interests of the students did not count. I call this research gone wild. On the other hand, there is the institution where a heavy teaching load takes up all the energies of every

faculty man. One extreme is as bad as the other. Where is the happy medium?

My proposition is that every technical school or department ought to put first things first. You can't get away from the fact that the individual student is the reason for existence of your department and your position. Good teaching, therefore, comes first. What time and interest you have beyond this can properly be devoted to research. There apparently is no good reason why a good teacher can not be a good research man, and vice versa, but the fact remains that some of the most valuable teachers I have known seemed to waste their time when on research, and I have had to remove successful research men from undergraduate classrooms because they were failures as teachers. The combination of a real research type with teaching ability is rare, much more so than I like to admit. It is all very well to say that every teacher ought to advance his profession by original contributions to its store of knowledge, but the fact remains that real contribution comes from a spontaneous creative urge and not from the desire of the college to see its professors' names in print.

Above all mineral technology research is not just another job to be expected of every teacher; it can only be worth while through the spontaneous enthusiasm of the worker. Thus I do not expect every good teacher to be a research worker. I think some men are wasting their time and energy in trying to do this work in slavishly following the accepted university tradition. Personally, I prefer to see at least part of my teachers use their spare time in regular commercial work. Let Professor A spend the summer in geological work for a coal company; let Professor B design in concrete work for a construction company; and let Professor C report on an oil field for some oil company. I think these men will come back to college in the fall with a point of view more valuable to the student than they would by spending an equal time in laboratory research. This is the peculiar distinction of engineering; it touches industry and modern life in a way not to be found in the liberal arts tradition and not even in the older professions. Let us recognize that there are other methods besides research in which a professor may benefit his industry and freshen his own point of view.

Finally I wish to speak of our ethics in attracting students to our campus. We are individually enthusiastic about our school and course and proud of our profession. Were this not so we would have no right to continue in our present positions. Years ago most of us chose our professional course by chance. The catalogue of our school contained only the information necessary for us to select our studies. Then came the era of competition and advertising. Do you ever think how far we have a right to go in

painting our professions as alluring and romantic, as offering good salaries for all who finish our courses, with a future bed of roses as a consulting expert. I quote roughly from several prospectuses and bulletins:

"Do you want to lead a life of adventure and romance?"

"A man so trained can make a prosperous living for himself."

"On completion of our course he has a thorough training both in theory and practice of his chosen profession."

We indeed want to inspire the young man, but is this the sort of inspiration that he needs? Could we not with equal truth tell him that some perspiration will be necessary?

You who live and work in college communities have been fortunate the last two years. My own office is in the center of a great industrial center. I have had so many young engineers come to me for advice and possible help during this time. They are not from any one school; possibly 15 schools scattered widely are represented. They are without jobs; some are without money; most of them are discouraged and puzzled; some are frankly bitter. I would judge some of them to be misfits in the profession they think they have learned. In reviewing the procession, my conclusion is that not only has industry failed in providing them jobs, but that you and I have failed in teaching them; we have given them a stone of technical details, when what they cry for is the bread of hope, of sympathy, of understanding. They want a philosophy by which to meet the realities of life. They have not found it in textbooks on mechanics, in their research problems, or in their college activities. My guess is that some of them never will find it. Let's do differently with our coming generations of students. Let's show them that nothing can take the place of a personal love and understanding between teacher and student. Let's be an example for them. Let's make them love their professional studies. In the mineral industries courses we have a great opportunity. Our classes are small; there is every chance for personal relations with the individual student. Let's not confine this relation to the necessary facts of his course; let it come out in a personal interest in the boy, in trying to make him see the world as it is, in teaching him that it's a world of people as well as of things; and although he can not in four years take formal courses in the intangibles of life, yet a sane point of view towards them is the greatest professional asset we can give this individual boy, this single boy who is the main reason for the existence of our schools.

ENGINEERING ENROLLMENTS, 1932–33

WALTON C. JOHN

Senior Specialist in Higher Education, Office of Education, Washington

DISTRIBUTION OF FOUR-YEAR UNDERGRADUATES IN ENGINEERING BY CLASSES, 1932–33

Year	Number of Institutions	Total Undergraduate Enrollment	Per cent	Classes							
				Freshman		Sophomore		Junior		Senior	
				No.	%	No.	%	No.	%	No.	%
1	2	3	4	5	6	7	8	9	10	11	12
1925–26	143	54,337	100	20,063	36.9	14,493	26.7	10,695	19.7	9,063	16.7
1926–27	148	59,853	100	22,765	38.0	16,123	27.0	11,562	19.3	9,403	15.7
1927–28	148	63,023	100	23,360	37.1	16,905	26.8	12,685	20.1	10,073	16.0
1930–31	145	73,386	100	25,332	34.5	19,631	26.7	16,262	22.7	12,161	16.6
1932–33	143	63,119	100	17,441	27.6	17,028	27.0	15,542	24.4	13,108	21.0

SUMMARY OF ENROLLMENTS IN 143 ENGINEERING SCHOOLS IN THE UNITED STATES IN 1932–33

Curricula	Freshman	Sophomore	Junior	Senior	Total Undergraduate	Graduate	Others	Grand Total
1	2	3	4	5	6	7	8	9
Electrical	3,957	3,873	3,690	3,005	14,525	833	72	15,430
Mechanical	3,564	3,579	3,304	2,864	13,311	596	77	13,984
Civil	2,963	3,031	2,887	2,499	11,380	563	70	12,013
Chemical	2,823	2,644	2,142	1,684	9,293	586	46	9,925
Architectural	618	562	490	481	2,151	80	20	2,251
Aeronautical	442	453	442	347	1,684	82	12	1,778
Mining and Metallurgy	242	230	246	257	975	80	22	1,077
Mining	174	220	183	144	721	34	6	761
Metallurgy	136	144	148	113	541	93	3	637
Other	2,522	2,292	2,010	1,714	8,538	980	210	9,728
Total	17,441	17,028	15,542	13,108	63,119	3,927	538	67,584

The T-SQUARE PAGE

DEVOTED TO THE INTERESTS OF THE DIVISION OF ENGINEERING DRAWING

FREDERIC G. HIGBEE, EDITOR

The 1933 Drawing Competition. Thirteen institutions submitted a total of fifty-six entries in the four classes. The drawings were on display throughout the annual convention and the unusual high quality of the work made the task of judging difficult. The committee of judges appointed by Chairman H. M. McCully were Professor Thomas E. French, Chairman; Professor Walter E. Farnham, and Professor Frederick W. Ming. These judges announced the following awards at the dinner meeting of the Division of Engineering Drawing:

Class A: "A pencil drawing made with instruments embodying an orthographic shape description only."

First place: Northeastern University, drawing by Joseph Hill, Instructor Laurence Cleveland

Second place: University of Illinois, drawing by H. L. Frank, Instructor L. D. Walker

Third place: Lafayette College, drawing by Paul W. Kinney, Instructor Harold J. Kennard

Class B: "A pencil drawing made with instruments, including both an orthographic shape and size description."

First place: Purdue University, drawing by A. Glade, Instructor P. E. Moose

Second place: University of Wisconsin, drawing by Charles Halamka, Instructor F. O. Griffith

Third place: Lafayette College, drawing by Marshall Sheldon, Instructor Harold J. Kennard

Class C: "An inked drawing made with instruments . . . which shall include all the features of a working drawing."

First place: Oregon State Agricultural College, drawing by A. W. Bedford, Instructor Earl C. Willey

Second place: Purdue University, drawing by P. F. Lilly, Instructor John M. Russ

Third place: University of Kentucky, drawing by William H. Pell, Instructor J. S. Horine

Class D: "A freehand pictorial sketch."

First place: Texas A. and M. College, drawing by R. O. Loving, Instructor H. C. Spencer

Second place: Northeastern University, drawing by A. L. Cerda, Instructor E. F. Tozer

Third place: Oregon State Agricultural College, drawing by Jack Graham, Instructor Earl C. Willey

The institutions submitting entries were Purdue University, University of Illinois, Union College, University of Akron, Oregon State Agricultural College, University of Wisconsin, Northeastern University, Columbia University, Texas Agricultural & Mechanical College, University of Detroit, University of Kentucky, Rice Institute, and the University of Iowa.